

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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No. 4

CONTENTS

- DIFFERENTIAL DIAGNOSIS OF CHRONIC PERFORATING CARCINOMA OF THE COLON.
Clyde A. Stevenson, M.D., and Arno W. Sommer, M.D. 485
- THE DOUBLE-CONTRAST EXAMINATION OF THE COLON. *James B. Douglas, M.D.* 490
- ROUTINE SEARCH FOR COLONIC POLYPS BY HIGH-VOLTAGE RADIOGRAPHY.
C. Gianturco, M.D., and George A. Miller, M.D. 496
- DILUTE CONTRAST MEDIA IN DIAGNOSIS OF LESIONS OF THE COLON.
Robert M. Potter, M.D. 500
- DOUBLE-CONTRAST EXAMINATION OF THE COLON WITH SPECIAL EMPHASIS ON STUDIES OF THE SIGMOID.
Robert D. Moreton, M.D. 510
- REDUCTION OF ILEOCECAL INTUSSUSCEPTION BY HYDROSTATIC PRESSURE.
Bertram R. Girdany, M.D., Lee Weil Bass, M.D., and George W. Grier, M.D. 518
- THE DETECTION OF EARLY CARCINOMA OF THE STOMACH. AN EVALUATION OF THE ROENTGEN EXAMINATION OF THE PATIENT WITH GASTROINTESTINAL SYMPTOMS.
Frederick J. Bonte, M.D., and Hymer L. Friedell, M.D. 527
- ANNULAR PANCREAS.
Andrew R. McGee, M.D., Leslie W. Black, M.D., and Homer Beattie, M.D., C.M. 532
- ROENTGEN FEATURES OF PULMONARY TUBERCULOMA. *C. C. Wang, M.D.* 536
- ROENTGEN AMNIOGRAPHY: A VALUABLE AND SAFE AID TO OBSTETRICAL DIAGNOSIS.
Eugene M. Savignac, M.D. 545
- LEFT ATRIAL CALCIFICATION. REPORT OF EIGHT CASES VERIFIED AT SURGERY FOR THE RELIEF OF MITRAL STENOSIS. *Joseph L. Curry, M.D., J. Stauffer Lehman, M.D., and Edward C. H. Schmidt, M.D.* 559
- MALIGNANT LESIONS OF THE TONSIL.
Dale B. Parshall, M.D., and K. W. Stenstrom, Ph.D. 564
- LATE EFFECTS OF THOROTRAST IN TISSUES.
Anthony P. Prezyna, Lt., MC USN, William W. Ayres, Cdr., MC USN, and William C. Mulry, Cdr., USN 573
- THE LETHAL DOSE OF WHOLE-BODY TANTALUM¹⁸² GAMMA IRRADIATION FOR THE BURRO (*Equus asinus asinus*).
John H. Rust, D.V.M., James L. Wilding, Ph.D., Bernard F. Trum, D.V.M., C. S. Simons, Ph.D., A. W. Kimball, Jr., Ph.D., and Cyril L. Comar, Ph.D. 579
- PLASTIC VAGINAL CYLINDER ACCESSORY TO THE EXPANDING CERVICO-UTERINE RADIUM APPLICATOR.
Edwin C. Ernst, M.D., Edwin C. Ernst, Jr., M.D., and Roland P. Ernst, M.D. 583
- A ROENTGENOGRAPHIC STUDY OF TRANSITORY SYNOVITIS OF THE HIP JOINT.
L. Drey, M.D. 588
- PALM THORNS AS A CAUSE OF JOINT EFFUSION IN CHILDREN.
Rolla G. Karshner, M.D., and William Hanafsee, M.D. 592
- EDITORIAL: THE ACUTE RADIATION SYNDROME. *Richard H. Chamberlain, M.D.* 596
- ANNOUNCEMENTS AND BOOK REVIEWS. 598
- RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES. 602
- ABSTRACTS OF CURRENT LITERATURE. 606

RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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No. 4

Differential Diagnosis of Chronic Perforating Carcinoma of the Colon¹

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IN A PREVIOUS analysis of the roentgenologic findings in 500 consecutive cases of carcinoma of the colon (1) seen at the Scott and White Clinic, chronic perforation was found to be present in 52 patients (10 per cent). In this group adequate pathological material was removed at operation for an accurate correlation of the gross changes with the preoperative roentgen findings. An additional 28 cases were excluded from the study because, although there was strong evidence indicating chronic perforation, material available for examination did not meet the requirements for critical analysis. This gave a total of 80 (16 per cent) out of 500 cases studied in which there was probable or pathologically proved perforation. Lesions distal to the rectosigmoid area and small sigmoid polyps were not included in the series.

We found that in the proved cases of chronic perforation the roentgenologic findings were unequivocal in 20 per cent, showing evidence of a fistula extending from the carcinoma to some adjacent organ. In the cases without fistula formation, the roentgen diagnosis of perforation was correct in 78 per cent.

This study has been continued, with examination of an additional 60 consecutive

cases of carcinoma of the colon seen since the earlier report. Adequate resected material was available for comparison with preoperative roentgenologic findings in 45 of these cases. There were 9 instances of proved perforation, giving no important percentage difference in regard to the incidence of chronic gross perforation.

Because this is a survey of the pathologic changes which produce alterations on the roentgenogram, microscopic studies have not been emphasized. Many patients with carcinoma without gross perforation were found to have microscopic extension or metastases.

In our study of the gross pathologic material we have attempted to reconstruct the specimen about the opaque barium shadow on the original roentgenograms, in an effort to determine the cause of the changes which permit a diagnosis of chronic perforation. The specimens showed that in non-perforated carcinoma most of the lesions were annular and constricting, with a sudden change from normal colon to carcinomatous tissue and then a sudden change back to normal. There was no mass extrinsic to the serosal surface. In the cases of chronic perforating carcinoma in which adequate gross

¹ From the Department of Radiology, Scott and White Clinic, Temple, Texas. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7-12, 1952.

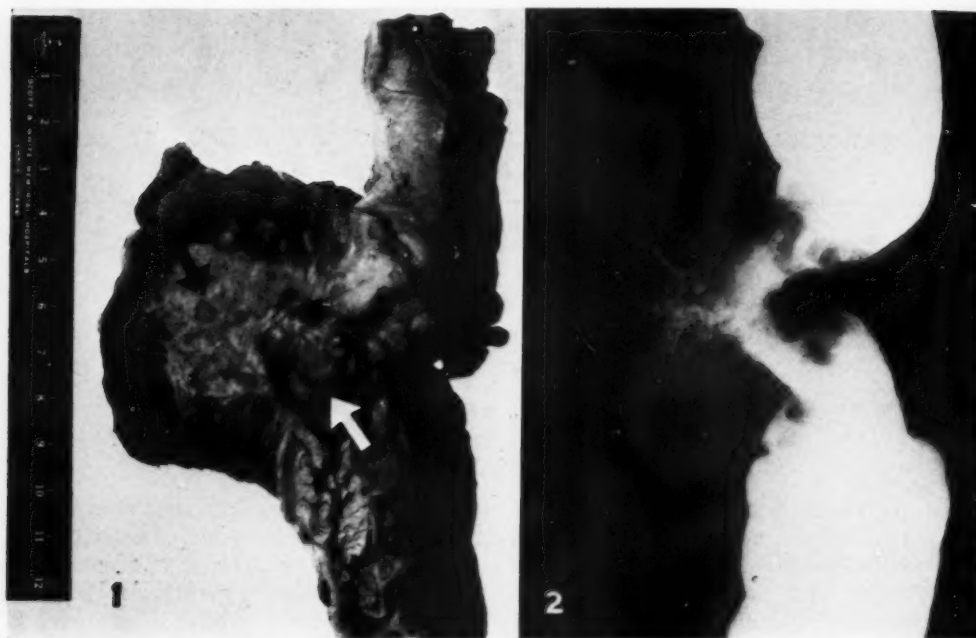


Fig. 1. Photograph of fixed pathologic specimen showing direct extension from the carcinoma through the bowel wall and into the mesenteric fat. The white arrow points to the intraluminal portion of the tumor. The black arrow indicates extension of the carcinoma through the bowel wall into the mesentery.

Fig. 2. Roentgenogram of a surgical specimen filled with barium immediately after surgical removal. Barium outlines the ulcer crater, which extends into the extrinsic mass in the mesentery.

specimens were available for study there was an extrinsic mass in all instances, ranging from 1 or 2 cm. in diameter to the size of a large grapefruit. The development of this mass was of interest and explains the roentgenologic recognition or failure of recognition of chronic perforation.

Figure 1 shows early direct extension from the base of the carcinoma, through the bowel wall, into the mesenteric fat. Thirteen of our 61 proved cases showed direct extension into the mesentery without any tendency for the mass to override the normal colon proximal or distal to the lesion. These masses were usually small; if they were large, the cecum was the site of perforation. This accounts for the 22 per cent error in diagnosis, in that the roentgen findings did not differ from those in cases without perforation.

When ulceration of the carcinoma was a prominent feature, roentgenologic recognition of perforation was made easy if the

ulceration permitted barium to extend beyond the normal limits of the bowel wall. Figure 2 is a roentgenogram of a barium-filled surgical specimen showing direct extension from a typical carcinomatous defect. In cases showing pronounced ulceration, the extension was into the mesentery or formed a fistula leading to a neighboring organ such as the small bowel, stomach, or bladder.

Seventy-eight per cent of the 61 specimens showed an extrinsic mass which not only extended directly out from the primary lesion but also extended proximally or distally, though rarely in both directions, to compress the normal colon above or below. Correlating the gross pathologic findings with the roentgenographic defect in these cases, the artist has superimposed the findings on the original roentgenograms. From drawings of a few typical cases it is easy to see the basis on which a roentgen diagnosis of chronic perforation may be made.



Fig. 3. Artist's drawing superimposed on the roentgenogram to illustrate the mechanical factors involved in the production of the roentgenographic findings. A large ulcerating carcinoma is visualized to the right of the arrow. An extrinsic mass, composed of a mixture of carcinomatous and inflammatory tissue, produces the deformity to the left of the arrow.

Fig. 4. Composite photograph to illustrate a type of change seen soon after perforation of a carcinoma of the colon occurs. An extraluminal mass, which is largely inflammatory, narrows the lumen proximal to the carcinoma. The carcinoma, indicated by the arrow, has penetrated the bowel wall. Proximal to this is the constricting inflammatory mass.

Fig. 5. Composite photograph to show how the extraluminal mass of carcinomatous and inflammatory tissues reduces the lumen of a segment of bowel. Mucosal markings in this compressed area were normal. The actual carcinoma, below the arrow, has not extended beyond the serosa.

Fig. 6. Composite photograph of an extensive annular carcinoma of the transverse colon, with perforation and formation of a large inflammatory mass proximal to the carcinoma. The black arrow points to the carcinomatous portion of the tumor mass, while the white arrow indicates the inflammatory component.

While the pathologic specimens varied considerably, all showed that the primary carcinoma perforated the colon wall and then, as a result of direct extension, formed a mass. This mass was usually made up in considerable part by inflammatory reaction but in a few specimens

roentgenologic findings in chronic perforating carcinoma of the colon. They have not been altered but merely emphasized by this study.

In the instance of a polypoid carcinoma with alteration of the bowel wall only at the base of the lesion, we were unable to

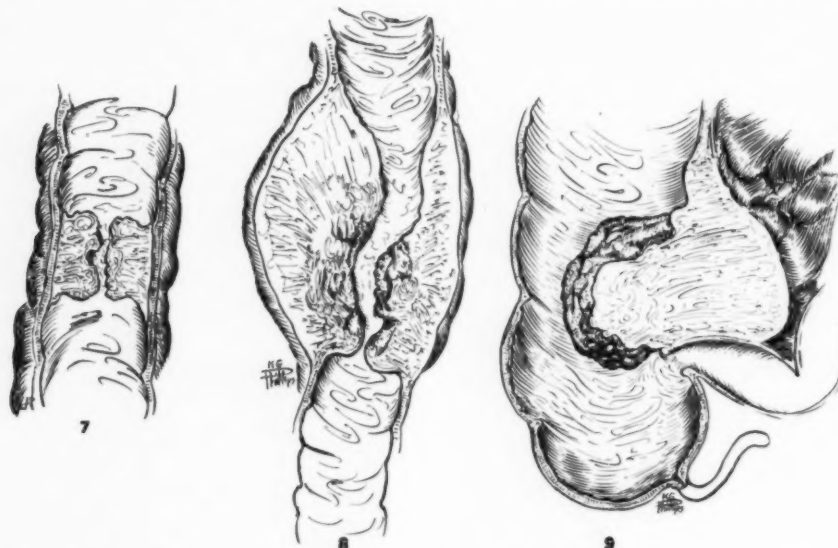


Fig. 7. Artist's representation of the average non-perforated carcinoma. Note the abrupt change from normal to abnormal and the tendency to intussusception at both ends of the tumor.

Fig. 8. Drawing of the average gross pathologic specimen when chronic perforation has occurred. There is abrupt change from normal to abnormal at the lower end of the specimen, with compression of the bowel by an extrinsic mass proximal to the carcinoma.

Fig. 9. Drawing to illustrate the changes frequently seen in the cecum and lower ascending colon. The large intraluminal polypoid carcinoma so distorts the bowel that evaluation of the extraluminal component is impossible.

was entirely carcinomatous. Figures 3, 4, 5, and 6 are representative of our findings in most cases. In each instance evidence of an annular carcinoma is present, in that there is a sudden change from colon to a narrow irregular channel with destruction of the mucosa in the channel area. At either the proximal or distal end of the channel, however, the colon is compressed by the extrinsic mass so that the return to normal colon is gradual rather than abrupt as in an uncomplicated carcinoma. On the original roentgenograms relatively normal colonic mucosa could be observed in the portion of the bowel narrowed by extrinsic compression. Weber (2), in 1936, established these basic

find any consistently reliable roentgen signs indicating chronic perforation. In some cases the extrinsic mass did exert pressure on the normal colon, but the presence of a large intraluminal polypoid tumor so distorted the colon that no consistent changes could be demonstrated. This was especially true of perforated carcinoma of the cecum.

Figures 7, 8, and 9 are drawings, in sagittal section, based on an average of our findings in the study of the pathologic specimens. Figure 7 represents the average non-perforated carcinoma, while Figure 8 shows the most common finding after perforation has taken place. Figure 9 shows how most of our errors oc-

curred. Note that in this figure extension through the bowel wall does not alter the appearance of the intraluminal portion of the polypoid neoplasm.

Surgeons (3) have often mentioned the fact that the cure rate in carcinoma of the colon is dependent to a great extent on the chronological age of the lesion at the time of removal. It is obvious that signs of perforation are associated only with late lesions. We may safely assume that a small polyp with malignant changes in its tip is an early lesion, and that an annular constricting carcinoma may be moderately advanced. The 22 per cent of chronically perforated carcinomas which could not be diagnosed by roentgenologic methods were far advanced; those in which the diagnosis could be made were probably even more advanced. It is apparent, then, that when a roentgenologic diagnosis of chronic perforating carcinoma is possible, the prognosis is poor.

SUMMARY AND CONCLUSIONS

1. Five hundred and sixty consecutive cases of carcinoma of the colon were stud-

ied (a) to ascertain the incidence of chronic perforation, (b) to review the criteria whereby perforation of the lesion may be recognized, and (c) to correlate the gross pathologic features with the roentgenographic findings.

2. Chronic perforation was proved to have occurred in 10 per cent of the cases of carcinoma of the colon while an additional 6 per cent revealed probable perforation.

3. By means of drawings we have attempted to illustrate the mechanical factors which combine to produce the characteristic roentgenologic findings observed in chronically perforated carcinoma of the colon.

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Temple, Texas

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SUMARIO

Diagnóstico Diferencial del Carcinoma Perforante Crónico del Colon

Estudiáronse 560 casos consecutivos de carcinoma del colon: (a) para averiguar la incidencia de la perforación crónica; (b) para repasar las pautas empleadas para el reconocimiento de la perforación; y (c) para correlacionar las características macropatológicas con los hallazgos roentgenológicos.

Hubo perforación crónica comprobada en 10 por ciento de los casos estudiados, en tanto que otro 6 per ciento reveló probable perforación.

El estudio de los ejemplares macropatológicos demostró que la mayor parte de los carcinomas sin perforación eran lesiones constrictoras anulares, con súbita transformación de tejido normal a carcinomatoso, y sin tumefacción fuera de la superficie serosa. En el carcinoma con

perforación crónica, había tumefacción extrínseca en todos los casos. Aunque en la mayor parte, ocurrió una transformación súbita del colon normal en un conducto irregular y estrecho con destrucción de la mucosa, el intestino estaba comprimido por la tumefacción extrínseca, de modo que el retorno a la normalidad fué gradual más bien que brusco, como sucedió en el carcinoma sin perforación.

Cuando existe un carcinoma polipoideo intraluminal grande, puede estar tan deformado el intestino que no permita determinar las alteraciones debidas a la tumefacción extraluminal.

Los signos roentgenológicos de perforación no se observan más que en el carcinoma avanzado, y cuando existen, el pronóstico es malo.

The Double-Contrast Examination of the Colon¹

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ALTHOUGH THE basic principles of the double-contrast examination of the colon have remained essentially unchanged for the past twenty-five years, some refinements have been added through the accumulation of the experiences of a number of observing radiologists. The contributions of Dr. Harry W. Weber, and of Drs. C. A. Stevenson and Robert D. Moreton and their associates have been especially stimulating and helpful. The Texas group has recently contributed excellent papers on preparation, materials, methods, and problems of interpretation (1-5).

Some investigators recommend high-voltage technic with a relatively thin barium mixture (6) and others add tannic acid to the barium and emphasize the post-evacuation film (7) for the detection of polyps and other abnormalities within the colon. It has been our experience, however, that the double-contrast examination is the most dependable procedure for the demonstration and evaluation of the intraluminal abnormalities of the large bowel above the level which can be inspected by means of sigmoidoscopy.

Regardless of special interest and of every effort to be conscientious and exacting, there are a significant number of cases in which the preparation of the patient and the demonstration of the mucosal relief of the colon are less satisfactory than is desirable. Re-examination has solved most of the individual problems, but we continue to explore all suggested refinements and improvements.

In preparation we have found no laxative which results in as satisfactory cleansing of the bowel as castor oil. We permit liquids such as strained broth and

black coffee or tea the evening preceding the examination, and usually a light breakfast the following morning. Due to the gastrocolic reflex this may result in some emptying of the terminal ileum, and when re-examination is required, especially if there is special interest in the right side of the colon, even the light breakfast is omitted. The patient is instructed to take three tap water enemas the morning of the examination.

We continue to search for the ideal opaque medium but at present employ a suspension of I-X barium in water as the preparation of choice. In our experience, neither the commercial colloidal barium nor the mixture with added tannic acid has been as satisfactory as this barium and water preparation. The suspension which we use is somewhat thicker than that used in routine barium enemas. It should not be too heavy, however, or it will not flow freely and will prolong and complicate the examination.

We believe that the routine barium enema and the double-contrast study should be considered as separate procedures. Careful fluoroscopic observation is essential in each and, although reasonable speed of investigation is desirable, we do not hesitate to take spot films when questionable findings are noted.

Dr. Moreton and his co-workers, in their paper on "A Simple One-Stage Method of Double Contrast Study of the Colon" (5), have described the maneuvering of the patient which they carry out in order to keep the head of the column dependent. Dr. Francis Polgar, writing about his "Contrast Enema in Lateral Recumbency" and "Aimed Gas Filling of the Colon" (8), also describes the position-

¹ Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7-12, 1952.

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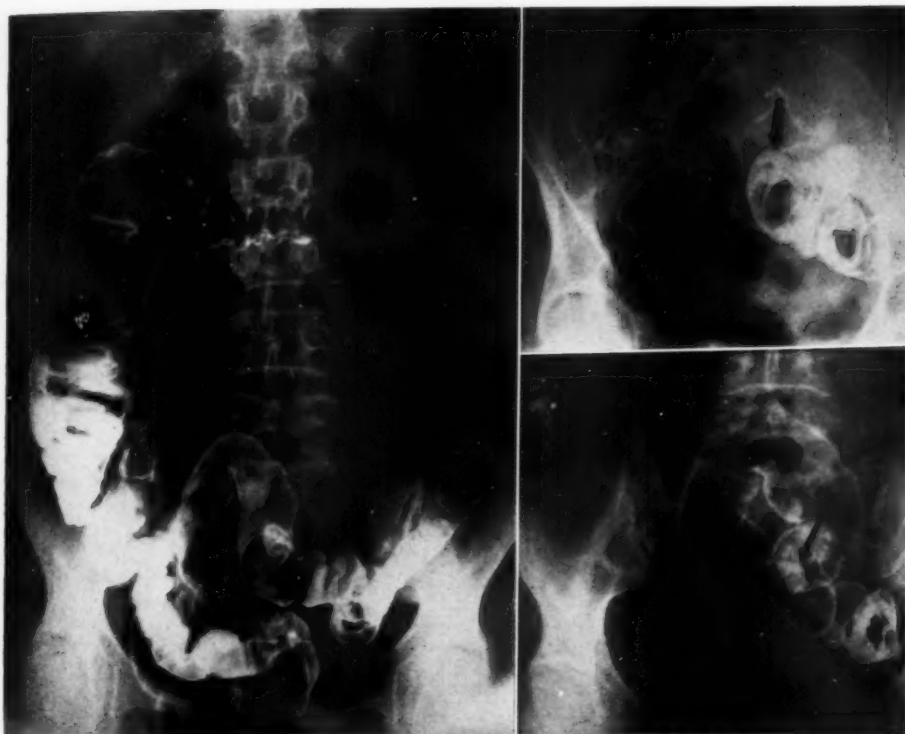


Fig. 1. Case I. Polyp in the sigmoid which could not be located at the original operation but was removed three years later. *Pathological diagnosis:* Adenomatous polyp with no evidence of malignancy.

ing of his patients. We have used the "one-stage method" and find it especially helpful in some hospital patients. In most of our cases, however, we continue to send the patient to the toilet for partial evacuation of the barium before insufflation. Even with this latter procedure the examiner can exert significant control over the distribution of the barium by manipulation of the patient.

If the amount of barium mixture present after evacuation is not excessive, any that remains usually can be redistributed by positioning. If the puddling is predominantly in the right side, it is helpful to inject air with the patient lying on the left side. Conversely, if less than the usual amount of contrast material has passed into the right colon, the insufflation should be done with that side down. When indicated, the table may be tilted up or down to facilitate the desired distribution.

Because of individual variations, especially the degree of flow into the ileum, it is not possible to select any definite volume of air which will result in optimum distention of the colon in all cases. While the patient should not suffer undue discomfort, the bowel should be well inflated with gas for I believe one of the most frequent causes for an unsatisfactory double-contrast examination to be insufficient distention of the colon. The anal canal is never obstructed except by the enema tube, thus preventing over-distention, and the insufflation is always done by the examining physician.

Stereoscopic films are made of the entire colon with the patient supine and prone, and a right anterior oblique view of the sigmoid region is obtained. The antero-posterior and postero-anterior projections are well worth the added effort because of difference in the distribution of the barium. Those flexures of the bowel which are most

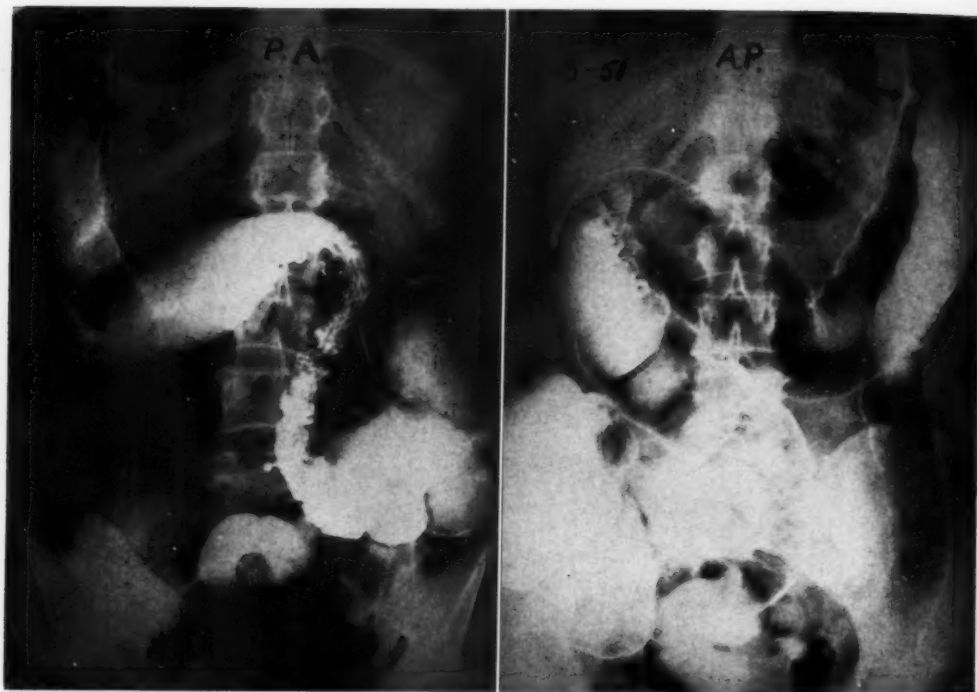


Fig. 2. Case II. This patient had *Endamoeba histolytica* in the stool and seemed to improve temporarily on antiamebic therapy. Pathological diagnosis: Poorly differentiated adenocarcinoma in polyp in distal transverse colon.

dependent in one projection and which are obscured by puddling will be uppermost in the reverse position and will almost invariably be well seen. Stereoscopic films are of real assistance in accurate localization and in the evaluation of densities observed.

Many of our double-contrast examinations are repeated, even when the original is entirely satisfactory, for when operation is to be done largely because of radiologic evidence, we prefer that the initial findings be confirmed by re-examination. It is common knowledge that polyps of appreciable size may elude even the most skilled and experienced surgeon, for these lesions may be so soft and velvety that they cannot be palpated through the wall of the bowel, and upon rare occasions the colon may be opened to permit direct visualization. When these difficulties in surgical localization occur, it is certainly reassuring to all concerned for the radiologist to have high quality films demon-

strating the lesion on two separate examinations. Teamwork and co-operation between the referring physician, the proctologist, the surgeon, the pathologist, and the radiologist are indispensable. Negative examinations in the presence of unexplained bleeding or other disturbing symptoms demand re-examination.

CASE REPORTS

CASE I: Mrs. P. J. O., a 57-year-old white woman, began having vague abdominal cramps in May 1947. There was no evidence of blood in the stools. Sigmoidoscopic examination demonstrated one polyp 3 mm. and another 3 cm. in diameter. The larger polyp was pedunculated and there was ulceration at the tip. There was some question of early carcinomatous change in the biopsy specimen.

The double-contrast examination demonstrated a pedunculated polyp at the junction of the descending with the sigmoid colon. A gallstone was also seen. In July 1947 a competent surgeon removed the gallbladder but, even after careful examination of the colon, could detect no evidence of an intraluminal mass, and the bowel was not opened.

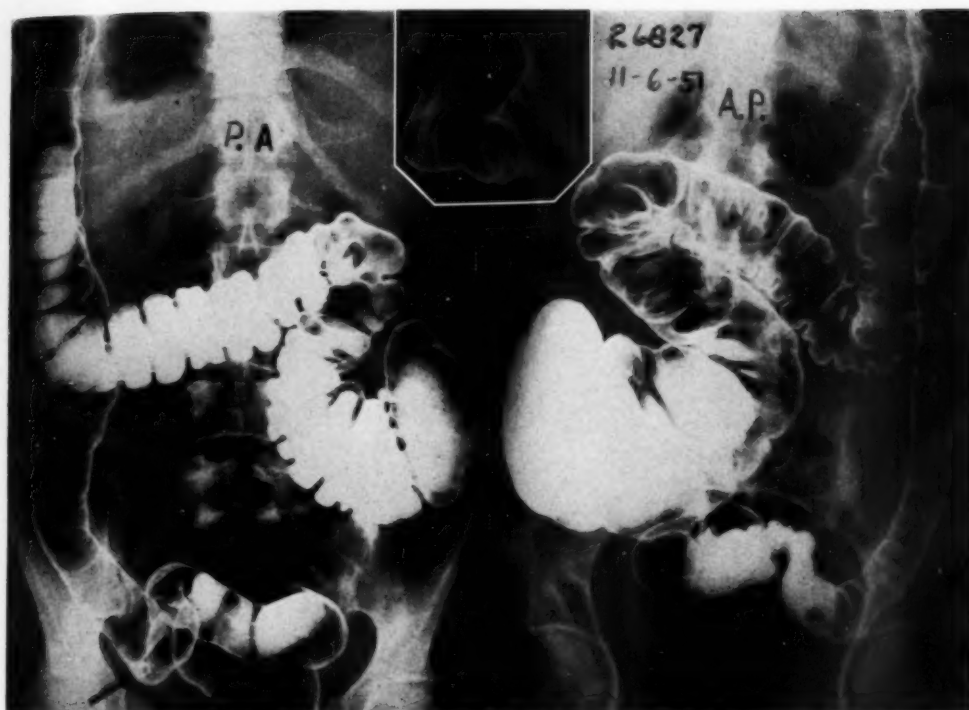


Fig. 3. Case II. Bleeding recurred following removal of a malignant polyp (Fig. 2) and a second polyp was found in the sigmoid, without evidence of malignancy.

In October 1950, the double-contrast examination was repeated because of persistent vague cramps, again without bleeding. The polyp was again demonstrated and a second surgeon located it with great difficulty. It proved, on removal, to be an adenomatous polyp with no evidence of malignant change. The patient is living as well with no recurrence of symptoms.

CASE II: Mrs. J. B. M., a 50-year-old white woman, began having diarrhea with streaks of bloody mucus mixed in the stool in April 1951. *Endamoeba histolytica* was identified in the feces. For two weeks there was an apparent response to antiamebic therapy, but symptoms recurred and a treatment failure was suspected. A double-contrast enema demonstrated a small sessile polyp in the distal transverse colon. At operation this proved to include poorly differentiated adenocarcinoma. Bleeding again recurred three months later and three double-contrast enemas were necessary before we were satisfied that a second small polyp was present in the sigmoid. At operation the same surgeon who had finally located and removed the elusive polyp in the preceding case, and who certainly appreciated the difficulty in surgical identification of a small lesion such as this, could not locate the polyp. There was, however, a plaque-like area of thickening

in the colon at this level and, because of the histology of the previous lesion, four inches of colon was resected. The thickened area proved to be due to endometriosis; the polyp, 1 cm. in diameter, was found within the specimen. It showed no evidence of malignancy. The patient has not bled since and is well one year later.

Comment: This last case emphasizes the importance of close co-operation between the physicians concerned in the management of such problems, as well as the difficulty in the surgical localization of lesions which have been demonstrated.

Polyps may occur in children, and the double-contrast examination for their demonstration is not particularly difficult. The preparation and technic are similar to those for adult patients except that the dose of castor oil is smaller. Bleeding is the most common presenting symptom, with severe constipation occurring less frequently. The danger of malignant alteration is, of course, not as imminent in the small child as in the young adult or



Fig. 4. Pedunculated adenomatous polyp in a 5-year-old girl with bleeding from the bowel. The inset is a spot film made with the colon filled. A. Double-contrast study. B. Postoperative examination three months later. Note pseudo-polyps due to bubbles of air, not constant in other films or at subsequent examinations. No bleeding or other symptoms.

older patient. However, continued loss of blood or other symptoms may necessitate prompt surgical intervention.

In multiple polyposis many of the lesions will be located in the distal portion of the colon. It has been our experience, however, that in a significant number of patients proved to have one or several polyps high in the colon, none were demonstrable in the rectum or rectosigmoid. I do not believe that the absence of polyps within the field of the sigmoidoscope should be considered conclusive evidence that polyps are not present higher in the bowel.

CONCLUSIONS

No two double-contrast examinations present exactly the same problem. Each case is an individual challenge to the resourcefulness and industry of the examiner. A method of examination which will yield a high percentage of satisfactory results is desirable.

Because of the well recognized fact that a high percentage of polyps of the colon will

develop into cancer, it is imperative that we continue to refine and improve our technic and interpretation until this difficult examination is as dependable as possible.

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SUMARIO

El Examen con Contraste Doble del Colon

El examen con doble contraste ha resultado ser el procedimiento más fehaciente para el descubrimiento y la justipreciación de las anomalías intraluminales del intestino grueso más arriba del nivel al cual pueden ser inspeccionadas con la sigmoidoscopia. Como medio opaco, se utiliza una suspensión de bario I-X en agua. En la mayoría de los casos, se ejecuta la insuflación después de la evacuación parcial del bario. Se toman radiografías estereoscópicas de todo el colon con el enfermo en decúbito dorsal y ventral y además una

vista oblicua anterior derecha de la región de la S ilíaca.

Se repiten muchos exámenes con mira a la confirmación, aunque el primero sea positivo. Los exámenes negativos cuando existen hemorragia inexplicada u otros síntomas requieren otro examen.

Debido al hecho bien reconocido de que un elevado porcentaje de los pólipos del colon experimentarán alteración maligna, es imperativo continuar los esfuerzos encaminados a perfeccionar la técnica del examen, a fin de poder descubrir aquéllos.



Routine Search for Colonic Polyps by High-Voltage Radiography¹

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COLONIC POLYPS play an important role in the development of cancer. These small growths are frequently discovered in the course of postmortem examinations. Bockus states that they were found by Stewart in 4.19 per cent of 1,815 autopsies, by Felson in 6.4 per cent of 955

TABLE I: ANALYSIS OF CASES

Patients examined.....	1,552
Patients with polyps.....	42
	(2.7 per cent)
Size of polyps	
Less than 1 cm.....	20
More than 1 cm.....	22
Transverse colon.....	3
Descending colon.....	15
Sigmoid colon.....	23
Rectum.....	1
Symptoms	
None.....	28
Bleeding.....	14
Surgery.....	22
Adenomatous polyps.....	16
Carcinomatous polyps.....	4
Lymphosarcoma.....	1
Lipoma.....	1

postmortem examinations, and by Lawrence in 2.8 per cent of 7,000 autopsies. The radiological incidence is usually much lower, since the barium enema cannot be expected to discover many of these small growths. The detection of colonic polyps roentgenologically can be improved, however, by the routine employment of sensitive methods of examination. Stevenson, Moreton, and Seedorf, and later Moreton, Cooper, and Foegelle, have perfected the technic of double-contrast study originally developed by Fischer and Weber. The use of semitransparent contrast media has been advocated by Ledoux-Lebard, Garcia-Calderon and by R. M. Potter. The advent of x-ray equipment capable of 120 to 130 kv. has made it possible to demonstrate small colonic growths by penetrating the column of barium with high-voltage roentgen rays.

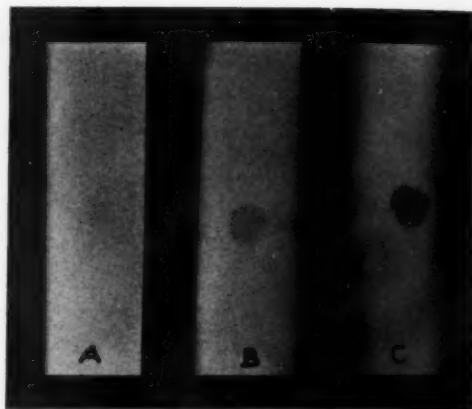


Fig. 1. Penrose drain containing barium and a paraffin pellet radiographed at 85 kv. (A), 100 kv. (B), and 120 kv. (C). Note increase in transparency of barium with increase of voltage.

The purpose of this paper is to report on the routine employment of high-voltage radiography in a series of adult patients undergoing general examinations. At our institution a general examination usually includes a roentgen study of the colon.

The high-voltage technic requires a barium mixture just dense enough to be fully opaque when fluoroscopy is conducted at 80 to 85 kv. This same mixture will become radiographically transparent at 120 to 130 kv. (Fig. 1). A suspension of this density is usually obtained by adding one part of barium to four parts of water by volume. It must be noted, however, that these proportions are not constant and they should be adjusted to the characteristics of the equipment employed. Once the proper density is found, the proportions of barium and water should be carefully controlled. We use a densitometer for this purpose, but the same result may be obtained by mixing known amounts of barium and water in quantities sufficient

¹ From the Carle Hospital Clinic, Urbana, Ill. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7-12, 1952.

for the day's work. The high-voltage radiographic exposure should be such as to show one loop of the colon through another (Fig. 2), and it is best controlled by phototiming. If the density of barium is properly balanced against the quality of the roentgen rays, polyps will appear as

pose of the multiple films and of the different positions is to dislodge gas and fecal material which sometimes persist in spite of the most painstaking preparation. If a translucent shadow constant in shape and position appears in the films, the examination is repeated on another day

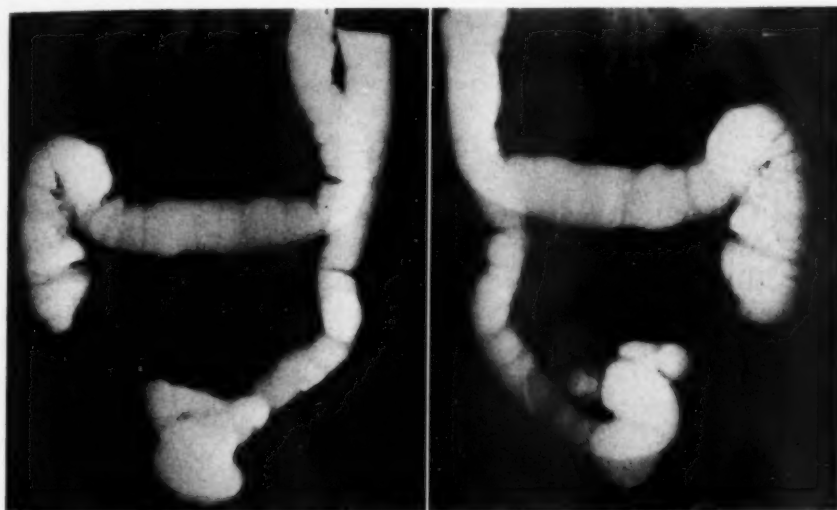


Fig. 2. Anteroposterior and postero-anterior views of the colon taken at 120 kv. Note the transparency of the loops.

translucent shadows just as cholesterol stones are visualized by the gallbladder dye (Fig. 3). Since translucent shadows may also be caused by gas or fecal material, the preparation of the patient is extremely important. Two ounces of castor oil are given the evening preceding the examination, and in the morning a number of cleansing enemas are administered in the x-ray department by specially trained personnel.

The actual examination is divided into two distinct phases. During the first phase the rectosigmoid is filled and examined under fluoroscopy. The flow of barium is then stopped, and films of this segment are taken in oblique and lateral positions at 120 kv. In the second phase, the flow of barium is resumed, the whole colon and, if possible, the terminal ileum are visualized, studied fluoroscopically, and filmed in anteroposterior and postero-anterior positions at 120 kv. The pur-

pose of the multiple films and of the different positions is to dislodge gas and fecal material which sometimes persist in spite of the most painstaking preparation. If a translucent shadow constant in shape and position appears in the films, the examination is repeated on another day

with the same preparation. A diagnosis of colonic polyp is rendered only if the shadow is shown by two separate examinations. The results obtained by this technic used routinely from March 1951 to March 1952 are shown in the accompanying table. The fact that polyps were found in 2.7 per cent of the patients compares favorably with the incidence of 2.8 per cent quoted by Lawrence in his study of 7,000 autopsies. It is interesting to note that in 28 of the 42 patients bleeding did not occur. Obviously these asymptomatic polyps would not have been detected without the routine employment of a sensitive method of examination. The finding of 4 carcinomatous polypi is particularly gratifying. All of these were less than 1.5 cm. in diameter.

On the other hand, one must note that this method of examination disclosed only one rectal polyp, though 9 rectal polyps



Fig. 3. Pedunculated polyp at sigmoid, demonstrable as a translucent shadow.

were found later, when 35 of the 42 positive patients were examined proctoscopically. The inadequacy of the procedure in the rectum has prompted us to add a routine proctoscopy to the roentgen examination of the colon. Since we can rely on the radiographs to show polyps in the sigmoid, the proctoscopic study includes only the length of the rectum and is practically free from discomfort. As a matter of expediency, it is done by one of the radiologists in the x-ray department and precedes the roentgen examination. During this proctoscopy no air is pumped into the bowel, and great care is taken to have the patients expel rectal air before withdrawing the proctoscope. One cleansing enema is given before the proctoscopy and two or more before the x-ray examination. These last enemas usually free the colon of any residual air which might interfere with the x-ray study.

At the writing of this paper 365 patients have undergone routine proctoscopy with the finding of 28 rectal polyps. This incidence of 7.6 per cent is similar to that reported by Hauch, Buie, Bargen, and Smith, who performed 1,919 routine proctoscopies in asymptomatic patients and

found that 8.1 per cent harbored rectal polyps.

The clinical significance of polyps has been shown by several authors. In a recent report, Ault states that 15 per cent of 325 polyps were malignant when first found. In 1947, Swinton and Warren were able to show that 14 per cent of 827 cases of cancer of the large bowel had developed from polyps. Five of our 42 patients carried malignant polyps.

The frequency of asymptomatic polyps must be noted. Only 14 of our 42 patients complained of bleeding. In the series reported by Castro, Ault and Smith, 75 per cent of the polyps gave no clinical symptoms. For this reason, Ault advocates routine examination of adults. Our results indicate that routine examination of the colon and rectum of adult patients is justified if we are to prevent the development of a substantial number of cancers of the large bowel.

CONCLUSIONS

1. Polyps in the colon and rectum of adults are frequently asymptomatic.
2. The possibility of malignant change and the actual malignant nature of some of these growths justify the routine employment of proctoscopy and of sensitive methods of roentgen examination.
3. High-voltage radiographs may be expected to detect polyps in about 2 per cent of adult patients.
4. The combination of high-voltage radiography and of proctoscopy may be expected to detect polyps in about 10 per cent of adult patients regardless of symptoms.
5. The high percentage of positive results makes the routine search for colonic and rectal polyps a fertile field for cancer detection and cure.

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SUMARIO

Busca Sistemática de los Pólipos Colónicos con la Radiografía de Alto Voltaje

En los estudios corrientes del colon de 1,552 enfermos con una técnica radiográfica de alto voltaje (120 a 130 kv.), en el transcurso de un examen general, se descubrió que 42, o sea 2.7 por ciento, tenían pólipos. Esa cifra concuerda de cerca con la comunicada por Lawrence en una serie de 7,000 autopsias, a saber, 2.8 por ciento. Encontráronse 4 pólipos carcinomatosos, todos ellos de menos de 1.5 de diámetro. Veintiocho de los 42 enfermos no tenían síntomas.

Debido a ser inadecuado el descubri-

miento roentgenológico de los pólipos rectales, se ejecuta también sistemáticamente la proctoscopia corriente, cabiendo esperar que los dos procedimientos unidos descubran pólipos aproximadamente en 10.3 por ciento de todos los pacientes, independientemente de los síntomas.

Vista la íntima relación entre los pólipos y el cáncer, la pesquisa sistemática de los pólipos colónicos y rectales constituye un aporte importante al descubrimiento y tratamiento de las lesiones malignas del intestino grueso.

Dilute Contrast Media in Diagnosis of Lesions of the Colon¹

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THE ROENTGENOLOGIST bears the responsibility for diagnosis of lesions of the colon above the level of direct visualization by the sigmoidoscope. With improved x-ray technic and dissemination of knowledge of methods of examination, there has been steady progress in diagnostic accuracy. There still remains, however, a reducible error, particularly in relation to small lesions of the colon.

As has been repeatedly emphasized, early and accurate diagnosis of small lesions, particularly those of a polypoid type, offers the best hope for successful treatment of cancer of the colon. The relationship of the two conditions has been well established. However, the probable multiplicity of polyps of the colon or rectum deserves re-emphasis. Statistical observations indicate that lesions of the colon or rectum will be multiple in 30 to 40 per cent of all cases (1, 4). We, as roentgenologists, should not be content, therefore, to think that our job is done when the presence of a single polyp has been established by x-ray examination. Such a finding, either by sigmoidoscopy or x-ray study, should be the signal for a careful search, which can be considered complete only when every portion of the bowel above the range of direct vision has been critically demonstrated on films with whatever contrast method is used. Repeated examination may be necessary for reasonable assurance that all portions have been covered, particularly in the presence of long redundant sigmoid colon loops which may be fixed in the pelvis. Close co-operation with the examining sigmoidoscopist is required, to make sure that

no part of the bowel has escaped observation either by direct vision or x-ray examination.

Faced daily with these problems, we naturally seek methods which will permit easier and more accurate diagnosis. Because of the limitations of present-day fluoroscopic methods, most small lesions will be discovered on film studies, with one or another contrast technic. Gross lesions may be detected by any or all of the usual methods.

For the past five years we have used in special studies of the colon, and for a shorter time in routine studies, a contrast medium of lesser density (3) than that which is usually employed. Barium suspensions with approximately 4.5 ounces of barium sulfate to a quart of water, with suitable suspending agents,² have been found to be sufficiently dense to show a good outline of the filled colon, both fluoroscopically and on the roentgenogram. At the same time displacement of the medium by small intraluminal masses can be appreciated on critical films made with high-kilovoltage technic. The aim has been to fill the bowel with a medium of sufficiently low density so that the density variation resulting from displacement of the medium by small intraluminal masses is not obliterated. We wish to achieve contrast *within* the bowel. Contrast between the contour of the filled colon and the surrounding tissue is easy to obtain.

Gianturco (1) finds that with a high-kilovoltage film technic (100 kv.), and barium enema suspensions approaching "normal" density, sufficient penetration is provided to demonstrate small intralumi-

¹ From the Department of Radiology, Northwestern University Medical School. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7-12, 1952.

² Dilute barium sulfate suspensions of sufficient stability not to deposit appreciable sediment during the time required for ordinary enema examination can be prepared in a variety of ways. A 2 per cent starch solution, although inconvenient to handle, will suspend ordinary U.S.P. barium sulfate adequately. Commercial barium sulfate preparations such as Veri-o-pake (General Electric Company) have proved easy to handle and satisfactory.

nal lesions. While it is true that many lesions can be demonstrated in this manner, further reduction of the density of the barium suspension should result in improved contrast when small lesions overlap the center of the bowel lumen or lie in large dense masses of barium, as in the cecum or right colon where the lumen is larger. We seek ideally a suspension of such density that, when the lumen is simply filled and moderately distended, the displacement of the translucent medium by any mass within the bowel can be detected.

Other methods of examining the colon, either in routine study or in special examination, have not been entirely satisfactory in our hands. Local compression of the bowel, with the use of barium suspensions of usual density, may demonstrate large intraluminal lesions in regions which are accessible to manipulation and external pressure. In portions of the sigmoid colon and in the flexures, in many patients, however, adequate compression cannot be applied to displace the dense medium to such an extent that there is any assurance of demonstrating small lesions. Mucosal pattern studies, after evacuation without air contrast and with or without tannic acid in the enema suspension, have improved the detection rate of small lesions in some hands. We have found that lesions a centimeter or less in diameter can easily be lost in folds of mucosa which have been well coated with contrast medium. There is no question that many larger lesions may be so coated that they can be detected in the collapsed bowel after evacuation. However, evacuation is not always complete and the remaining pools of dense barium in colon and distal ileum can obscure even larger lesions in redundant and overlapping sigmoid loops. These loops are perhaps the most critical region because of the statistical predominance of polypoid adenomas and small cancers in the sigmoid.

Air contrast examination, either as a supplementary procedure immediately following a routine barium enema or as a

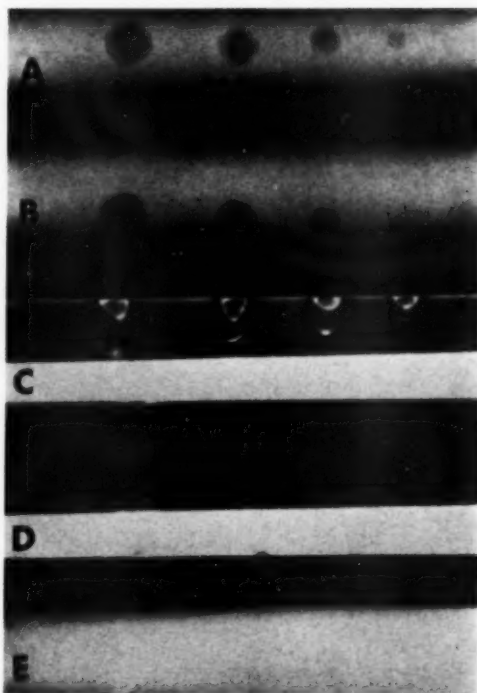


Fig. 1. To illustrate simply some of the problems of detection of small lesions of the colon, a lucite tube 3 cm. in diameter, with four balsa wood balls, approximately 15, 12, 9, and 5 mm. in diameter, attached to the wall, was filled with barium suspension in varied concentrations, with and without air for contrast and filmed under various conditions. No attempt was made to reproduce exactly the conditions of a barium enema study.

A and B are filled completely with "dilute" barium suspension and filmed with high-kilovoltage technic. All these small "lesions" are easily seen both when lying in the main mass of the barium centrally and when at the periphery. In C, D, and E the tube is less than half filled with a dense barium solution such as is ordinarily used in enema study and filmed with lower-voltage technic to increase contrast. Only in tube C, which is rotated to bring the lesions out of the barium mass and in good air contrast, are the lesions seen. In the others they are obscured completely by the remaining pool of dense barium occupying less than half the lumen of the tubes.

special study, offers perhaps the best theoretical conditions for detecting small lesions of the colon. The critical contrast between the finely coated bowel and the air distending it has provided a widely accepted and respected method of bowel examination. The mechanics of the air-contrast procedure, however, are such that it does not lend itself to broad or routine application and it is usually reserved for

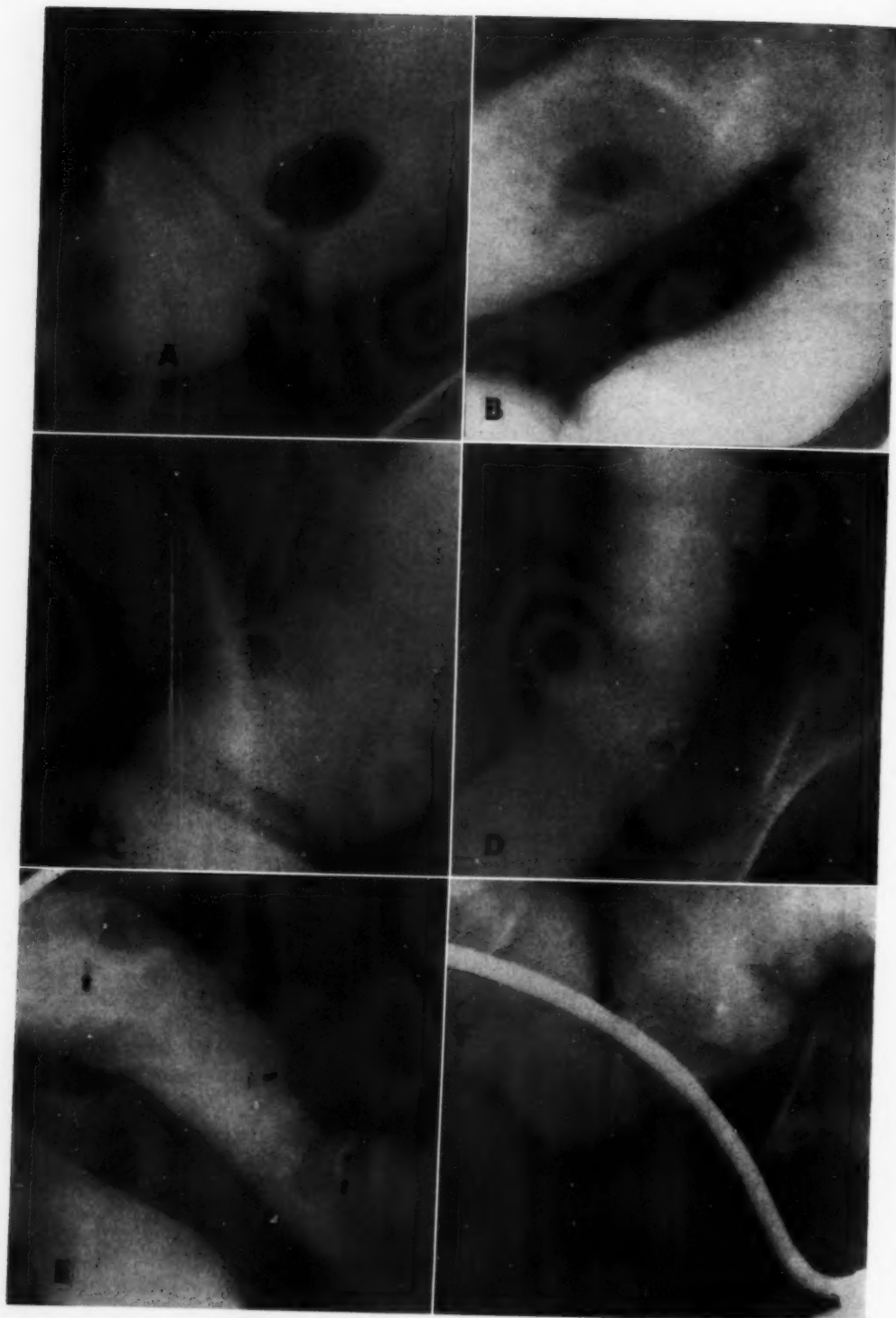


Fig. 2
502

special cases in which lesions have already been found or are definitely suspected. With this method again, difficulty may be encountered in achieving a uniform coating of barium over all portions of the colon without pools of dense barium remaining as a result of incomplete evacuation. And again the critical areas of the redundant sigmoid may be poorly visualized. Methods have been suggested to overcome these difficulties. These include filling of only a portion of the left bowel followed by rapid evacuation and air injection, as well as filming in prone and supine positions, or in right or left lateral decubitus, to cause the residual barium and air to shift by gravity. There is no question that many excellent studies of the colon have been accomplished by the air-contrast technic when all of the requirements for successful examination have been met. Figure 1 C, D, and E illustrate simply some of the difficulties which may be encountered when the optimum conditions have not been attained.

We have found that in routine and in special examinations, by simply filling the bowel with a dilute suspension of barium sulfate and obtaining well penetrated grid films to cover all portions, free of overlap, we have a method which is sufficiently critical to detect numerous lesions less than 1 cm. in diameter. High-kilovoltage radiographic technic (85 to 100 kv.)³ aids in penetrating the dilute barium, and its displacement by small lesions can be detected. The patient may be positioned with fluoroscopic control to aid in clearing

the overlapping loops by angulation. Extrinsic pressure is also helpful in separating the loops.

The sharpness of the fluoroscopic image with the barium enema suspension which we employ depends upon the volume of barium distending the lumen. When the bowel is moderately distended, the filled contour is well seen, and gross lesions extending into the lumen can be well visualized. Any region where the bowel will not distend is an area of interest to the examiner, and an indication for film studies. It becomes less important to attempt to examine the colon fluoroscopically, inch by inch, when one knows that the examination will be supported by films which will show any polypoid lesion ordinarily detectable fluoroscopically and many lesions not thus detectable.

Certain difficulties are inherent in this method as in others. A clean bowel is essential, since the method is critical enough to demonstrate small fecal remnants which may be obscured by the ordinary dense barium suspension. In fact, until one uses a dilute barium enema contrast medium, he never realizes how much material may remain in a bowel that would appear quite clean in the usual enema study.

In practice, after suitable preparation of the bowel, it is filled under fluoroscopic control and filmed with high-kilovoltage technic so that all portions are free of overlap, if possible. In some cases this study may consist of two or three 14 × 17-inch grid films made at various angles, supplemented where necessary with special views to clear the sigmoid or other redundant areas, made either with the tube over the table or with a high-kilovoltage spot-film device with grid. These films

³ We have not yet had experience with kilovoltages over 100 kv. On the basis of experimental data and examination of thin individuals, it is probable that with film technic up to 125 kv. more dense barium suspensions should be employed.

Fig. 2. A. Typical pedunculated polypoid lesion of lower descending colon about 25 mm. in long axis. This type of lesion is usually easily detectable with all methods of study.

B. Two lesions of the mid-sigmoid. The larger is pedunculated, measuring about 20 mm. in its long axis. The other is sessile, about 3 or 4 mm. in diameter. C. The lesion in the lower descending colon, measuring about 5 mm. in diameter, was one of two; the other in midtransverse colon measures 9 or 10 mm. in diameter. D. The larger of the two lesions measured 10 mm. in its longest axis; the other about 8 mm. These were the only two lesions found in this case. E. The four lesions of the mid-sigmoid range from 10 mm. to about 3 mm. in diameter. Two other 5-mm. lesions were found in the transverse colon in this case. F. The 5-mm. lesion on the right side of the transverse colon was one of nine lesions found in this case. Five lesions, the largest 10 mm. in diameter, were found in the cecum; two, about 10 mm. in diameter, were found in the descending colon and another, about 20 mm. in diameter, in the sigmoid adjacent to the site of an old anastomosis after resection for carcinoma.

are developed while the patient evacuates and are examined. Any area of lessened density, where the barium is displaced in the lumen of the bowel, is considered suggestive of an intraluminal mass. The colon may be filled again and special attention directed in filming to those areas previously considered suspicious. If the area of displacement of the barium reappears faithfully on the film, showing similar size, shape, and position, or if a pedicle is demonstrated, an intraluminal polypoid lesion must be considered. The diagnosis should rest on repeated examination and repeated demonstration of the lesion.

There are certain sources of confusion. Fecal masses offer difficulty, as in other techniques. They do not occur, however, in repeated examinations, with the same size, shape, and position. They are often flat or flake-like, but do not displace as much barium as a rounded polypoid lesion of similar area. Air bubbles trapped in fixed loops of bowel have also offered great difficulty since, as occasionally happens, they may be faithfully repeated at the same place, in the same position, on separate fillings of the bowel. These are very round and smooth and lack the irregular surface often seen in polypoid lesions. Diverticula of the colon, partially filled or ringed or outlined with barium, may cause real confusion when overlapping the bowel. This problem, which is not peculiar to this particular technic, can usually be solved by angulation and rotation.

Figure 2 shows typical results obtained with dilute barium suspension and high-kilovoltage roentgen technic. Except for

the lesion in A and the larger lesion in B, which represents the more usual type of pedunculated polypoid lesion of fair size (20 mm. or over in longest diameter), multiple lesions were present in all these cases varying from 3 or 4 mm. to 10 mm. in diameter. The mass of these small bodies was sufficient to displace the contrast medium to such an extent that the displacement could be seen and appreciated with critical film study.

COMMENT

The outstanding advantage of the method of examination described here is that it will reveal small lesions of the colon. All the other diagnostic features of barium enema study have been retained. Large filling defects, variation in caliber of the lumen, fixation, and the distribution of the colon in the abdomen, can be determined. Our experience would indicate that any routine barium enema examination which employs film studies of the filled colon could be made more critical by reducing the density of the barium suspension and increasing the penetration by high-kilovoltage film technic.

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SUMARIO

Medios de Contraste Diluidos en el Diagnóstico de las Lesiones del Colon

Sobre el radiólogo recae la responsabilidad de diagnosticar las lesiones del colon más allá alcance del sigmoidoscopio. Para el descubrimiento de lesiones pequeñas,

que pueden frecuentemente pasarse por alto con los habituales procedimientos con enemas de mezclas espesas de bario, ha dado buenos resultados un medio de menos

densidad (135 gm. de sulfato de bario en 1 litro de agua, con agentes suspensivos adecuados).

No tan sólo permite esto descubrir

el contorno del colon, sino que puede observarse el desplazamiento de pequeñas masas intraluminales en las radiografías tomadas con la técnica de alto voltaje.

DISCUSSION

(Papers by Stevenson and Sommer; Douglas; Potter; Gianturco and Miller)

Harry M. Weber (Rochester, Minn.): Presented here were three papers dealing with refinements of roentgenographic technic aimed particularly at demonstrating the lesion which I believe is best described by the term "polypoid lesion," and one dealing with the most commonly encountered complication of intestinal cancer, perforation and infection. In all instances, the arguments were convincing and the demonstrations excellent.

Dr. Sommer's paper deserves attention and study, chiefly, I think, because we have been reminded once again that perforation of intestinal carcinoma produces a change in its general structure, both gross and roentgenologic, that makes the lesion appear to us, as well as to the exploring surgeon, more like an inflammatory lesion than a neoplastic one. We tend to describe, rather glibly on occasion, a time-honored but still valuable set of positive criteria for our diagnosis of neoplasm—a syndrome which holds equally true when a neoplastic lesion invades any hollow viscus with a mucous membrane and an active muscular coat. Perforation obscures these criteria in one of two ways, or in a combination of them: (1) by opening up avenues of infection into the pericolic tissues, producing what can be called "infected neoplasm"; (2) by permitting rapid and gross extension of the neoplastic process, producing a lesion much larger than the original lesion would be without the complication.

The complication rarely submerges the roentgenologic criteria for neoplasm completely or beyond retrieve. Some evidence for the basic neoplastic process can practically always be elicited, but it may take some doing, as Drs. Stevenson and Sommer showed. They described and illustrated the pathogenesis very well, and succeeded admirably in correlating the gross pathologic changes produced and their roentgenologic interpretation.

The time to keep this fine paper in mind is whenever a lesion is encountered which lacks the features ordinarily and almost classically and pathognomonically associated with a neoplasm. A good and rewarding discipline to follow is to regard every deforming lesion in the intestine, in fact in the entire gastrointestinal tract, as neoplastic until utterly convinced that in that particular case it just cannot be so.

Drs. Douglas, Potter, and Gianturco all expressed or implied certain common ideas and convictions. They seemed to be persuaded as to the malignant potentialities of the intestinal polypoid lesion; they

derive their zeal for uncovering lesions of this type from the realization that if anywhere and at any time there is a diagnosis of early cancer in which the rate of cure should be high, this is it. They appreciate the importance of a clean surface of mucous membrane, if an effective roentgenologic diagnostic yield is to be expected. Twenty years or more ago, this was by no means so universally accepted as prerequisite for a satisfactory intestinal examination, even among radiologists. The essayists have come to realize that there is no royal road of ease and complacency in intestinal roentgenology; there still is no intestinal examination or diagnostic maneuver which will guarantee satisfaction at a single session every time. All of them are pursuing the search for a translucent or transradiable contrast medium with which to depict the intraluminal lesion which is so small that it will not produce readily noticeable deformity of the external contours of the region of the intestine it inhabits. Dr. Douglas is doing this with the double-contrast maneuver, Dr. Potter with a relatively dilute suspension of barium sulfate in the contrast enema, and Dr. Gianturco with a contrast enema similarly diluted but with the additional factor of high-voltage roentgenography to increase penetration. I can go along entirely with these aims and with the convictions expressed.

Has any one of the maneuvers described any particular advantage over the others? Seeing or having experienced shortcomings, difficulties, inevitable disappointments in all of them, I cannot produce an unequivocal answer to this question. Since Dr. Douglas's approach is much the same as the one to which I have become habituated, I would naturally be inclined to understand his paper more readily and would tend to be more sympathetic with his attitude. The real test of superiority of one diagnostic procedure over another is the diagnostic yield. In the case of intestinal polyps, this means not only how many of them are discovered and verified, but also how many of them are overlooked. Nowadays, it is a little difficult to get caught overlooking these lesions. Surgeons hesitate to perform an exploratory operation in the absence of convincing roentgenologic evidence of intestinal abnormality. All of the methods described will demonstrate, or can be made to demonstrate, polypoid lesions so small that the surgeons often encounter real trouble finding them by transintestinal palpation and transillumination, and the roentgenologic approach is the only one available for that part of the intestine above

the level of proctosigmoidoscopic reach. The last diagnostic word, therefore, is often that of the roentgenologic examiner. Patients, especially those who do not have alarming or threatening symptoms, are not so likely to leave me or you, to go to Dr. Potter or Dr. Gianturco or Dr. Douglas, who might succeed in discovering a significant lesion greatly to the embarrassment of those of us who were less painstaking and less diligent in our examination. In a broad way, I am trying to indicate some of the reasons why we are so relatively infrequently apprehended in the error of omission.

How often should polyps be discovered in the intestine? What is the incidence of intestinal polypoid lesions? Our usual source of information about the incidence of disease is derived from the statistics of postmortem examinations. Dr. Gianturco quoted Lawrence, who reported an incidence of 2.8 per cent in 7,000 necropsies; he had just reason to be gratified that his examination yielded an incidence which was practically identical with that found by Lawrence. Such statistics, however, should be considered with caution. Obviously, it is necessary to know precisely what an investigator means when he uses the term "polyp." Did he include every tiny excrescence on the surface of the mucous membrane, regardless of its histologic structure? Or did he restrict the term to some more specific histologic type of lesion? What were his lower limits of size? Did he consider only lesions that were readily visible to the naked eye? Was the entire large intestine from cecum to anus searched? What was the predominant age and sex in the post-mortem series? Statistics from different sources vary within such wide limits that the ordinary analyst easily becomes disconcerted; he finds that he cannot trust himself to derive any very practical conclusions from them. For instance, Dr. R. J. Jackman studied the results of a series of 2,784 post-mortem examinations in which intestinal polyps were incidental findings in male and female persons whose ages ranged up to and including 89 years. He gave me permission to quote some figures. The overall incidence of intestinal polyps in this group of cases was 12.6 per cent. Of the total number of patients, 1,196 (about 42 per cent) were less than fifty years of age, and the incidence of polypoid lesions in this group was 5.2 per cent; 1,536 patients (55 per cent) were between the ages of fifty and seventy-nine years, with an incidence of 14.2 per cent; 898 patients (32 per cent) were between the ages of sixty and seventy-nine years, with an incidence of 22.3 per cent—almost 1 of 4. These figures are probably low because patients with frank intestinal cancer were excluded from the series. The disease appeared to be rare in children and young persons, with an incidence of 1.6 per cent below the age of ten years, 2.4 per cent below the age of twenty years and 2.5 per cent below the age of thirty years. Apparently, it might be possible to find a set of statistics which would justify almost any diagnostic yield below 25 per cent. Nevertheless, statistics

from postmortem examinations provide the best information we have as to incidence.

As to the relative merits of double-contrast methods and examinations with dilute media, with or without high-voltage roentgenographic technic, I would only make the comment that in the examination of the colon, as in the examination of many other organs, we have the good fortune to be able to choose, combine, and adapt roentgenoscopic and roentgenographic maneuvers to suit our individual talents, training, bent, taste, prejudice if you will, equipment, and—most important of all—the demands of the particular problem before us. Do you like roentgenoscopy? Have you learned to do it well, and have you done enough of it to do it with economy of time, yet competently, and with the necessary skill of maneuvering the patient, the screen, and the palpating hand, to become confident of what it can be made to reveal to you? If so, then you will probably lean the more heavily on the diagnostic elements thus derived and maintain roentgenoscopy as your cardinal and most dependable maneuver. Are you by nature, or by training, or by intellectual bent, or possibly by a healthy respect for or apprehensiveness of radiation damage, or perhaps on account of the demands of your consultants, more inclined to roentgenography? Then you will lean more heavily on roentgenographic techniques. You will do more "spot-filming," more double-contrast examinations, or you may adapt Gianturco's or Potter's procedures, or elements of all of these, to your own particular way of doing things. And you're bound to do well, but not unless you are willing to go all out, and be as painstaking and solicitous as they are. In this field, as in others, there might well be several good and equally productive means to the same end.

We do not use the dilute barium-high-voltage technic at the Mayo Clinic. I can assure you that it is not because we have been unfamiliar with it; Dr. Gianturco experimented with this idea when he was with us almost exactly twenty years ago, and he tried to convince me of its merits at that time. I recognized its possibilities then, as I think I do now, but I think it has its shortcomings in the diagnostic approach to intestinal lesions other than polypoid lesions. This particular maneuver simply does not seem to fit into my own personal general scheme of things, with some of the diagnostic criteria and the sense of practicability I happen to have developed. Possibly this attitude of mine can be blamed on the reaction all too frequently found in association with advancing antiquity. I might accept such an indictment with good grace if I personally did all of the intestinal work in our department myself, or controlled it with a heavy hand. But there are six other examiners on the consultant level in our department who share the intestinal work with me. Our approach to the problems of intestinal diagnosis has been essentially identical for many years. We rely heavily on roentgenoscopy. We have carefully studied and agreed upon the minimal concentration

of the opaque component of our contrast suspension, which is approximately equal parts of barium sulfate and water. A greater dilution than this would, we think, diminish our roentgenoscopic efficiency, although we have other reasons for using this relatively high concentration of barium sulfate in our opaque enemas. We are able to find small polyps, or at least become suspicious of their presence, at roentgenoscopy. None of us feels that this requires a special virtuosity. We are not often caught overlooking them. We know that we overlook some of them, but we also have had, on occasion, the unpleasant experience of having missed large lesions. I cannot be convinced, however, that a change in procedure would prevent or even diminish our omissions appreciably, because we find that these are rarely faults of method, but practically always conspicuous personal lapses.

There is merit in all of the types of intestinal examination described in this symposium. They are all good, and probably equally effective means to the same end. Having little patience with those who tend to hold up their own procedure as the only good and effective one, I hope not to have seemed to try to convert anyone to mine except as mine might happen to fit someone's individual attitude and talents.

I close with congratulations to these authors for the excellence of their presentations, with my thanks to them for having permitted me to see their papers in time to read them carefully, and get the remarks that occurred to me arranged in orderly fashion, and with a salute to the Program Committee for this very interesting session.

Leon Schiff, M.D. (Cincinnati, Ohio): It is indeed a pleasant privilege for a clinician interested in digestive tract disease to appear before a body of roentgenologists, since he is so dependent on the roentgen findings in the diagnosis of colonic lesions beyond the reach of the palpating finger or the proctosigmoidoscope. I can only re-emphasize what the speakers have already stressed, that is, the importance of attaining the highest degree of diagnostic efficiency through improved technics, so that small lesions may be recognized as well as larger ones.

The importance of early recognition of cancer of the large bowel is well known in view of the relatively high rate of curability in operable cases. The roentgen detection of polyps in the colon is equally important since the great majority of them cannot be suspected clinically and malignant change, if it has occurred, is usually of a low grade.

A careful study of rectal polyps done by Colvert and Brown in Mateer's Clinic at the Henry Ford Hospital revealed that 6 per cent of the polyps were malignant and probably so from the start or early in their development. I realize that there is a difference of opinion as to whether polyps be-

come malignant in the course of time or whether they are malignant from the beginning. This difference of opinion in no way lessens the importance of the recognition of these lesions. It cannot be assumed that a polyp is benign because it is small, smooth, pedunculated, or sessile. The only proof of the histologic nature of the polyp is in the microscopic examination.

I have only recently done a proctoscopic examination of a physician of some seventy years with a non-ulcerating rectal polyp about 1.0 cm. in diameter, which, on microscopic section, has been shown to be malignant. He had had no bleeding but had been experiencing mild digestive tract symptoms which in all probability had nothing to do with his polyp.

I want also to re-emphasize the importance of adequately preparing the colon for roentgen examination, and would like to cite an experience which has been very thought-provoking. A man forty-three years of age, with symptoms interpreted as due to a functional bowel disorder, had had no bleeding. The proctoscopic examination was negative, but a double-contrast barium-enema study (two-stage method) done by a most competent radiologist in May and repeated in June, and again in November, revealed on each occasion a polyp about 2 cm. in diameter in the mid portion of the sigmoid colon. Castor oil and repeated enemas were used in preparing the patient for each examination. Laparotomy was advised, and when the sigmoid colon was palpated at operation it was thought to contain a number of small polyps which were marked by placing black silk threads in the bowel wall. When the sigmoid colon was opened, there were no polyps, but a number of small fecal masses were adherent to the mucosa. Fortunately, the patient recovered from the operation without further incident. I don't know just exactly how to prevent a similar mistake in the future, and I would like to hear some comments from Drs. Douglas, Potter, and Gianturco in this regard.

Of Dr. Sommer I would like to ask the relative frequency of involvement of the right and left half of the colon by the perforating type of carcinoma he described. One would expect the right half of the large bowel to be the usual site of such a lesion.

I would like also to ask Dr. Gianturco if the lymphosarcoma which he described in one of his patients looked any different from the usual small adenomatous polyp.

Henry P. Plenk, M.D. (Salt Lake City, Utah): When I first saw the program of this afternoon's presentations, my first reaction was that it really was a shame to waste a whole afternoon discussing the more or less technical details of colon examinations. I thought that we all ought to know about this already. But I do think that this reminder of

how difficult this examination really is, with a suggestion for new, improved technics, has definite value. After listening to this excellent group of papers, I will return home and try to improve my own technic to emulate the high standards set by the essayists.

I am personally surprised at the high incidence of perforated lesions in Dr. Sommer's series and I wonder if he has any explanation as to why he finds so many lesions of this type.

I believe Dr. Bell wanted me to say a few words about our own experience with polyposis of the colon. We are taking part in a rather long-range project to investigate the genetic incidence of cancer in our geographic area. As many of you know, Utah is rather fertile soil for this type of study because of polygamy in the past, as well as the excellent church records of families in the area.

In the course of these studies we encountered a family with a very high incidence of polyposis of the colon. Of 24 persons in the first four generations, 13 were known to have polyps or have died of carcinoma of the large bowel. In 3 members of the next two generations, most of whom have not yet passed adolescence, definite polyps have been demonstrated and removed. It is also remarkable that only one member of this family has lived beyond the age of fifty-two years, most of them having died of carcinoma of the colon.

In the course of examining this group of patients, we discovered a rather unusual complication: All patients with polyps had also evidence of external "bumps." We became greatly interested in that aspect and examined the skeletons of every one of the patients carefully and discovered a rather amazing fact: Every patient who had polyps of the colon also had tumors arising from bone. Most of these were in the facial bones, some in the bones of the skull, and occasionally there were associated tumors arising from the long bones as well.

The condition that we are dealing with has been described in the literature as "leontiasis ossea." I would like to present a typical example of a case of leontiasis ossea from the literature for those of you who may not have seen a case of this disease recently. [A slide was shown at this point.] This is a rather extreme example with extensive proliferation of bone and complete blindness due to invasion of the orbits. Our cases were not quite as severe as this. We found very extensive tumors of bony density arising from the mandibles, as well as many other tumors arising from most of the other facial bones.

The lesson we learned from this study is that, if we spend a little time investigating a particular problem or learning more about some single aspect of a problem, our efforts will be rewarded even if the problem appears to be rather trivial. I personally was not very interested in polyposis

of the colon, but I am extremely interested in tumors of bone.

J. Maurice Robinson, M.D. (San Francisco): I feel that I am qualified to discuss these papers because I use or have used practically every barium-enema technic that has ever been presented before this Society. I have some decided opinions about what does and what does not work, and have come to this conclusion: the technic which works beautifully on Monday isn't worth a darn on Tuesday. You may be required to use every method available. None of them can be relied upon completely.

I have a few words to say concerning Dr. Potter's paper. If one could rely on maintaining the density of the barium suspension, perhaps thin mixtures such as he recommends would be of value. What not infrequently happens with such suspensions, and even with denser suspensions, is this: the patient still has some retained fluid in his bowel; the barium is diluted by this fluid and the shadow of the polyp is lost almost completely (or completely) in it, for if you wanted to conceal a polyp in a medium, you would make that medium of approximately soft-tissue density, giving you zero contrast. For this reason, among others, one may find in a barium-enema study that some films show the lesion beautifully and others, which seem to the eye equally satisfactory, fail to reveal any evidence of its presence. I know, furthermore, from bitter experience, that thin barium suspensions often will not stick to the bowel wall or to a lesion projecting into the bowel. As Coe and Hampton and their associates have shown, some polyps can best be detected on the evacuation films. In addition, many of these lesions, as you well know, will first be detected by fluoroscopy, even though radiographic confirmation may be required. Visual acuity of fluoroscopy being what it is, it is questionable if decreasing it still further by thinning out the barium mixture is well advised.

Obviously the proper barium suspension is the one which reveals the lesion best. What this mixture is in any one instance, I do not know. I do not doubt that a little bit of barium in a lot of water will be the right one in more than one case, but it is not the full answer to our problem.

Dr. Gianturco's technic, on the other hand, is an unusually well thought out series of procedures designed to yield the greatest amount of information for a given expenditure of time and energy, never inconsiderable. Every step in it has some significance. Its general adoption will lead to a rather definite improvement in the results we can obtain. A thoroughly cleansed bowel, proper radiographic penetration of an adequately dense medium, and a concentration of the study on the areas most commonly involved—in these lies the secret of his success. I predict

that his method will become our basic procedure and that other forms of examination will be supplementary, even though these may on occasion reveal information not obtained by his method or may be required to confirm or refute a first impression.

Henry C. Crozier, M.D. (Los Angeles): It has been accepted that the finding of a small filling defect or any small or early pathological lesion of the colon by any method requires a second examination for confirmation. Patients nearly always suspect that the first examination was not satisfactory when asked to return for a repeat study. A second examination necessitates a second preparation, and even I would object to that. Also, there is the economic objection, since a second examination means an additional loss of time to the patient and additional cost to the examiner.

We have tried to overcome these objections by doing a double study on the same day. We do the air contrast study first, followed by the regular or conventional study.

The double study is done only in cases with a history of the passage of blood in the stool or in cases in which blood is seen on proctoscopic examination. We hope to report in the near future on the advisability and the value of the double study on the same day.

Dr. Sommer (closing): Dr. Schiff has raised the question as to the relative incidence of perforation in the left and the right half of the colon. In our series, the few acute perforations have been in the right half of the colon. Two-thirds to three-fourths of the chronic perforations occurred in the left half.

In answer to Dr. Plenk's question regarding our high incidence of chronic perforation, it is our opinion that carcinoma perforates more frequently than is generally realized. The actual incidence can be discovered only on examination of every gross specimen of resected carcinoma. In our studies, 185 surgically removed gross specimens of carcinoma of the colon were studied. We made a somewhat less detailed study of the non-neoplastic and inflammatory lesions of the colon seen during this time. It was found that a relatively high degree of accuracy is possible in the roentgenologic differentiation between the carcinomatous and the inflammatory and non-malignant lesions of the colon. We also feel that it is desirable, and in at least three-quarters of the cases possible, to make the roentgenologic diagnosis of chronic perforation of the colon when it is present.

Dr. Douglas (closing): I have nothing further to say except to thank the discussants. In regard to the case cited by Dr. Schiff in which three examinations done several months apart consistently demonstrated the same convincing evidence

of a polypoid lesion, though none was found at operation, I am familiar with no method which can completely exclude such a possibility. Fortunately, I believe these occurrences are exceedingly rare.

Dr. Potter (closing): It is assumed that in Dr. Schiff's case the lesion was demonstrated beyond reasonable doubt three times. This leads us to the conclusion, assuming that it was demonstrated, that it either sloughed off or the surgeon didn't find it. This brings to mind one thing which deserves mention. In your talks with your surgical colleagues, emphasize that when they hunt for small polypoid lesions by palpation of the bowel wall, there is the very reasonable consideration that they may not be able to feel the lesions with their fingers. And if you have demonstrated such a lesion beyond reasonable doubt, you (and the patient) are entitled to have the suspected portion of the bowel examined by a sterile proctosigmoidoscope through a colotomy wound.

Dr. Robinson points out that retained water in the bowel ruins an examination with dilute barium. There is no question about that. I don't get much water in the bowel because I have my patients take their last preparatory enema about four hours before they come to see me.

Dr. Gianturco (closing): Dr. Schiff has asked about the gross appearance of the lesions in our case of lymphosarcoma. These lesions could not be seen with the proctoscope. The microscopic diagnosis was made by the excision of an inguinal node and the patient was given roentgen therapy. Dr. Weber has mentioned the wide discrepancy to be found in the autopsy reports on the incidence of polyps. This discrepancy may be due to the different age groups considered and to the different sizes of the adenomatous growths included in the various pathological studies. In our paper we quoted the figures given by conservative writers.

As for the comparative value of the various methods of roentgen examination, I believe that this value cannot be established today because we have too few reports on the radiological incidence of polyps and also because the results obtained depend so much on the proficiency of individual workers. Having trained under Dr. Weber and having learned much from him and from Dr. Moreton, I know that double-contrast examinations give excellent results. Dr. Miller and I prefer high-voltage radiography with dense barium because we find that this technic gives us the best yield of positive findings, allows a complete and satisfactory fluoroscopy, and is easily employed as a routine. We hope that increased emphasis on routine examinations will result in more frequent detection of early asymptomatic cancers of the colon regardless of the technic employed.

Double-Contrast Examination of the Colon with Special Emphasis on Studies of the Sigmoid¹

ROBERT D. MORETON, M.D.

IN LENGTH AS well as in position and arrangement, the sigmoid varies within wide limits as compared with other portions of the colon. Its average length is about 45 cm. and it commonly takes a spiral or figure-of-eight course. Sometimes, however, it is short and straight, making a direct connection between the rectum and the descending colon. Occasionally it is longer and may be present as a long, straight loop ascending from the pelvis to the level of the first or second lumbar vertebra or higher. On the other hand, it may appear as multiple loops, referred to by Weber as a "tangled festoon." Regardless of the type, a complicated arrangement of the sigmoid coils is the rule and their adequate roentgen exposure is often difficult.

In addition to this coil arrangement, the sigmoid is usually confined within the boundaries of the bony pelvis, making it inaccessible to manipulation, and direct visualization of each portion by roentgenoscopy is frequently difficult and at times may be impossible.

This small portion of bowel is most important pathologically. Buie *et al.* emphasized this in their distribution studies of polyps and frank carcinoma in various divisions of the large intestine: 70.5 per cent of the carcinomas and 71.2 per cent of the polyps were found in the rectum and sigmoid. It has further been established that 60 per cent of the malignant and potentially malignant lesions of the large intestine occur in the rectum and in that portion of the sigmoid colon which is within reach of the 25-cm. proctosigmoidoscope. It is generally said, moreover, that 50 per cent of the malignant neoplasms occurring in the rectum are discoverable on digital examination.

The roentgenoscopic examination of the sigmoid and rectum is no substitute for proctosigmoidoscopy. As has been stated in earlier papers, the radiologist should not be responsible for any lesion at this level. Ideally every patient having a roentgen examination of the colon should also have a proctosigmoidoscopic examination, though it is appreciated that in many instances this is not feasible in large clinics and to a lesser degree in private practice. Also, a great majority of the smaller rectal lesions will undoubtedly escape detection on digital examination (Fig. 1). This we have been taught should be a routine, but we nevertheless see patients in whom it has not been done referred for study of the colon. Even in those patients who have had the ideal examination there are frequently so called "dark areas" in the sigmoid, just above the limit of sigmoidoscopic visualization but below the clear area of roentgenoscopic demonstration, making it impossible to examine the area by either method.

For these reasons, I believe we should try to examine these areas as adequately as possible. Occasionally we may find suspicious shadows, in which event we can request proctosigmoidoscopic examination for confirmation of a suspected lesion. Double-contrast studies with oblique and lateral views or stereoscopic films have cleared most of the "dark areas." Lately I have been interested in trying to separate the loops of bowel to get an entirely different view of the sigmoid than we have usually obtained. Normally the sigmoid has a free mesentery and possesses a considerable degree of motility. I have tried increasing the Trendelenburg position, making exposures with the patient in both prone and supine positions, with only fair results.

¹ Presented as part of a course on "Roentgenologic Examination of Colon," The Postgraduate Course in Radiology, Extension Program in Medicine, University of Kansas School of Medicine, Kansas City, Kans., Feb. 25-27, 1952.

A modified knee-chest position has been of little value. The position described by Raap (Fig. 2A and B) has been found of most value and I would like to discuss it briefly with the modifications I have used.

This is an old position, first described in 1923 as the Chassard-Lapiné position. It has been employed for several specific conditions, such as septic disease of the hips (4) as well as for measuring radiation dosage (5) and in roentgen measurement of the pelvic outlet (9). Views obtained in this position, which I refer to as the "sitting position," have been found valuable as a supplement to the oblique, lateral, and other projections now used in searching for obscure lesions of the colon. We cannot tell just where the sigmoidoscopic examination ends or be sure that there is an overlap with the roentgenoscopic examination. It is believed that this view helps to assure more adequate examination of this portion of the sigmoid and affords a better chance of discovering small lesion when cure is probable. Upon discussing the matter with Camp and Hare, I realized that the view is seldom used and should probably be publicized for its value and as a confirmation of Raap's work.

I obtain this view after the patient has evacuated barium until air is being passed,

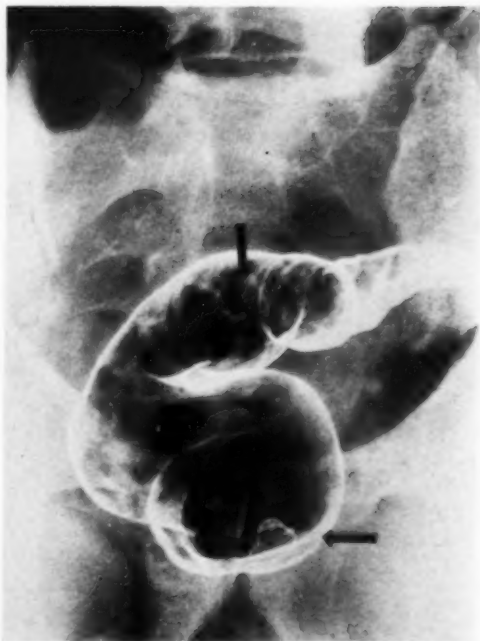


Fig. 1. Evacuation air study of sigmoid and rectum revealing a proved polyp in the rectosigmoid and another rather low in the rectum. Digital examination of the rectum was negative and no proctoscopic examination was made before the roentgen study.

as previously described (7). A film is first taken in the prone position (Fig. 3A) and then the "sitting view" is obtained (Fig. 3B). The film is inserted in the Bucky tray before the patient is placed in position,

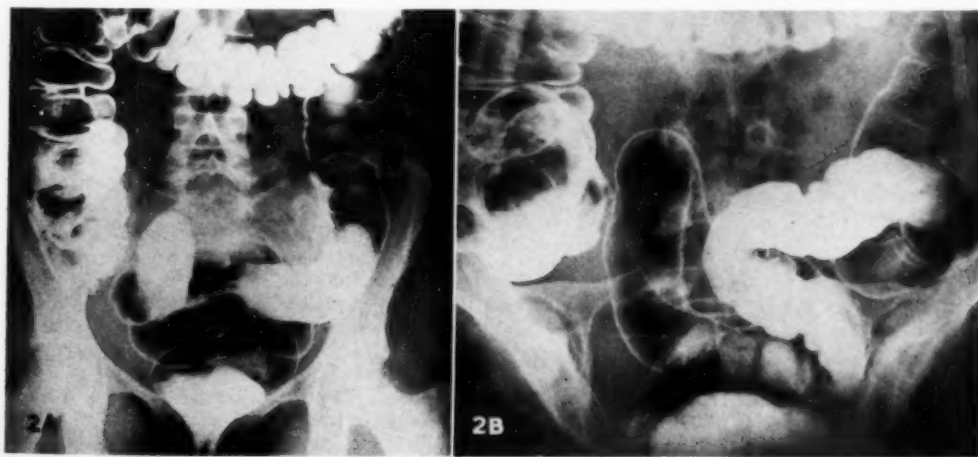


Fig. 2. A. Coiled arrangement of loops of sigmoid in the pelvis, frequently seen. B. "Sitting position" film, giving a clearer look at some of the obscure loops.

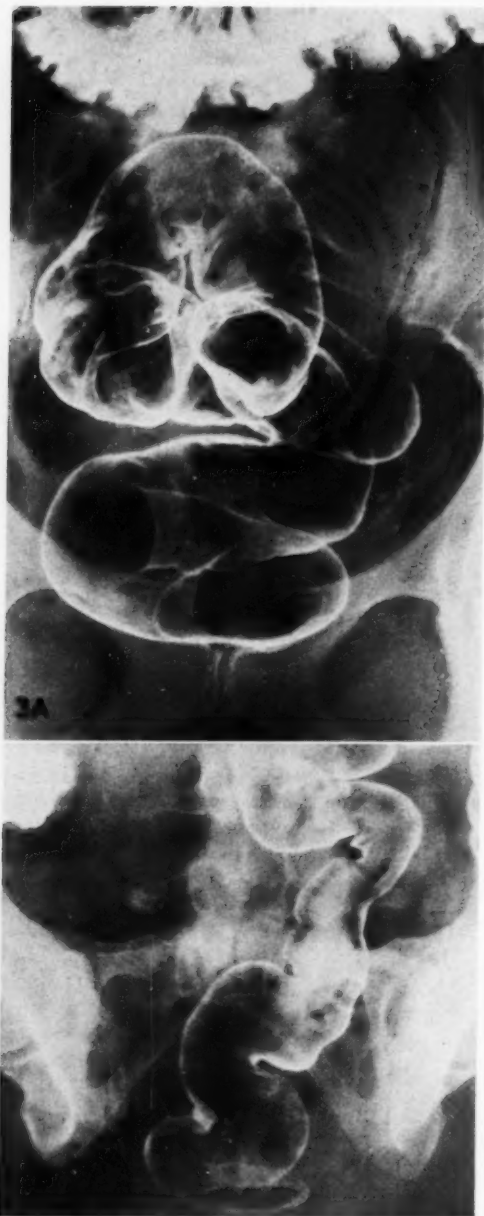


Fig. 3. A. Evacuation air study of sigmoid and rectum showing overlapping loops.

B. "Sitting position" film showing straightening of these loops and better visibility of this segment of the bowel.

since the legs prevent access to the tray. A 14 × 17-inch film is used, at right angles to the anteroposterior plane of the pelvis. The patient sits on the side of

the table with the greater trochanters in the mid-line. With the feet on a stool, for security, he bends forward as far as possible, and the central ray routinely passes through the spine and sacrum.

Radiographic factors are practically the same as for lateral projections of the pelvis. In the average patient I use 90 kv.p., 40-inch distance, and 150 to 170 milliamperes seconds. The greater the flexure of the patient, the lower the milliamperes seconds required.

A few cases in which this view has provided maximal visualization of the sigmoid and thus proved of definite diagnostic value are presented.

CASE I: A 62-year-old white man complained of increasing constipation, with occasional passage of red blood. Proctoscopic examination revealed internal and external hemorrhoids. Roentgen examination showed an essentially normal colon except for a few diverticula, best visualized in the "sitting position" (Fig. 4A and B), which cleared the overlapping sigmoid loops.

CASE II: A 53-year-old white woman complained of pain and occasional cramping in the left lower quadrant of the abdomen. She had not passed blood but had episodes of constipation during the attacks of pain. Examination of the colon revealed diverticula of the sigmoid with probable residual diverticulitis. The postero-anterior view (Fig. 5A) shows some of the diverticula in the proximal sigmoid. The "sitting position," however (Fig. 5B) reveals much more clearly the true extent of this involvement.

CASE III: A 34-year-old white man complained of change in bowel habit of three months duration. He had previously had one "good movement" each morning, but recently had several small movements a day and felt as if "something blocked him off." He had passed red blood for over a year and had been examined proctoscopically and roentgenologically on three previous occasions.

Proctoscopic examination revealed hemorrhoids and a proctitis, with some bleeding from the mucosa. This appeared as a local inflammatory reaction and had been previously described. A rather large polyp on a long pedicle was nicely demonstrated on double-contrast films in the oblique position (Fig. 6A). A "sitting position" film also showed the polyp in clear view, descending into the sigmoid on evacuation and practically blocking the entire lumen, acting as a ball valve (Fig. 6B). The polyp was removed and the patient has had no further trouble for the past year.

CASE IV: A 42-year-old white woman complained of passing both bright and dark blood from the

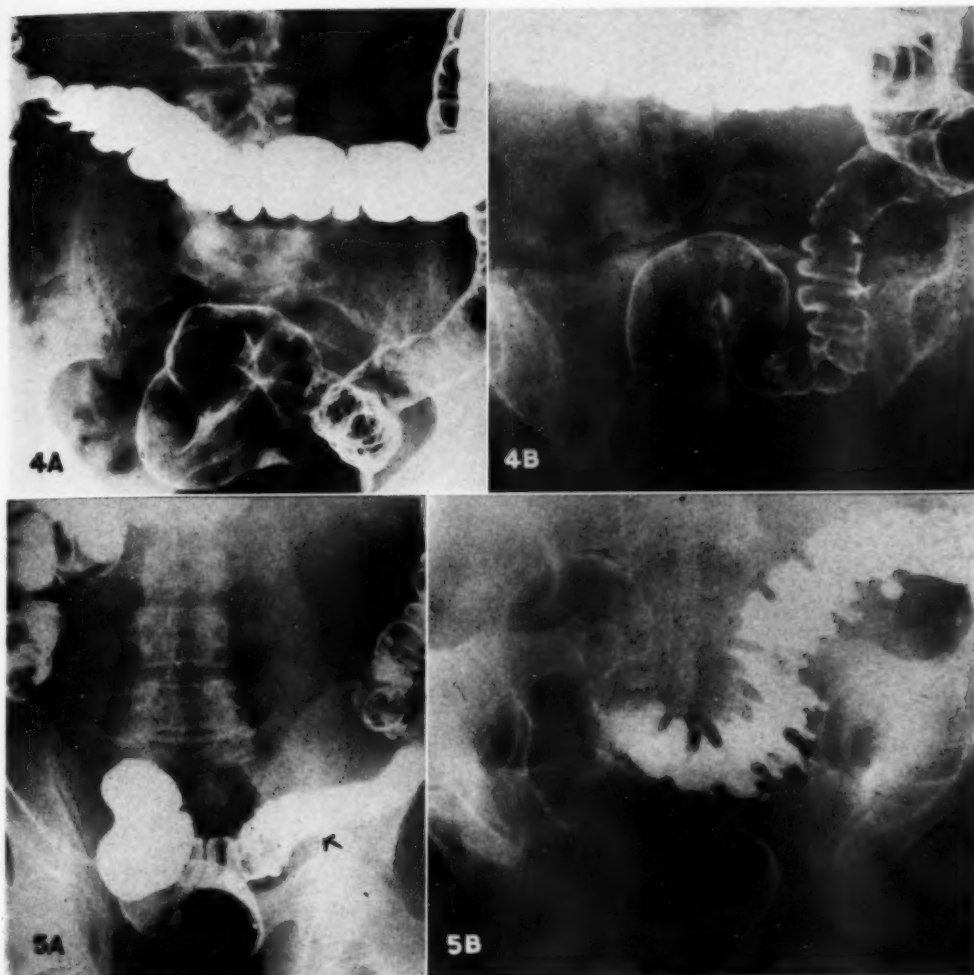


Fig. 4. Case I. A. Evacuation type film showing one or two diverticula in the redundant sigmoid. B. "Sitting position" film clearing overlapping loops and demonstrating the diverticula, enabling one to rule out other lesions in these segments.

Fig. 5. Case II. A. Postero-anterior view of colon showing multiple diverticula of the sigmoid. B. "Sitting position" film clearly showing the extent of involvement of this segment of sigmoid.

bowel. She had had a polyp removed from the rectum a year previously. Proctoscopic examination was negative to 22 cm., but some blood was seen coming from above that point. Double-contrast examinations of the colon revealed a polyp on fluoroscopy. This was best shown in the left posterior oblique position (Fig. 7A) through an air-filled loop of sigmoid. In the "sitting position" film (Fig. 7B) this area of the sigmoid is projected in open view and the polyp is well visualized, not being obscured by the overlying loop of sigmoid.

CASE V: A 22-year-old white man complained of pain in the right lower quadrant. He gave no his-

tory of change in bowel habits, diarrhea, or bleeding and had had no proctoscopic examination, being referred for visualization of the appendix and to rule out disease in the cecal area. Fluoroscopic examination and routine films were normal. An evacuation film of the sigmoid in the postero-anterior projection (Fig. 8A) showed no abnormality. A "sitting position" film (Fig. 8B) gave a better view of the redundant loops of sigmoid and revealed a small polyp not previously seen. The patient's history, apparently in keeping with a recurring appendicitis, led to operation with removal of the appendix and the polyp which had given no symptoms.

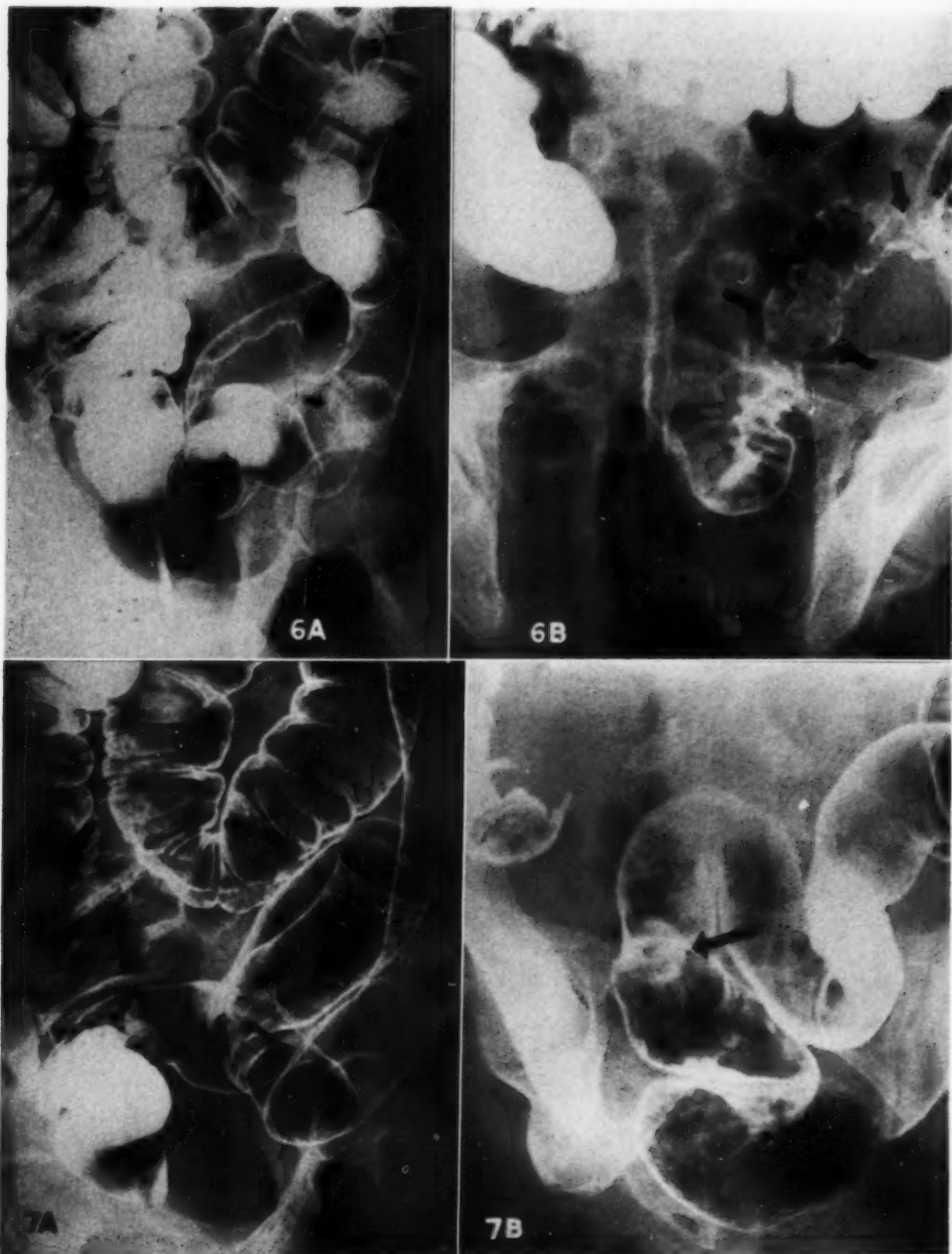


Fig. 6. Case III. A. Polyp in sigmoid well visualized in oblique position.

B. "Sitting position" film showing extent of the mobility of the polyp, due to its long pedicle, and "ball-valve" type of obstruction produced in segment of sigmoid.

Fig. 7. Case IV. A. Rather large, broad-based polyp viewed through air-filled loop of sigmoid with patient in oblique position.

B. "Sitting position" film showing same polyp to excellent advantage, as well as adjacent loops of bowel.

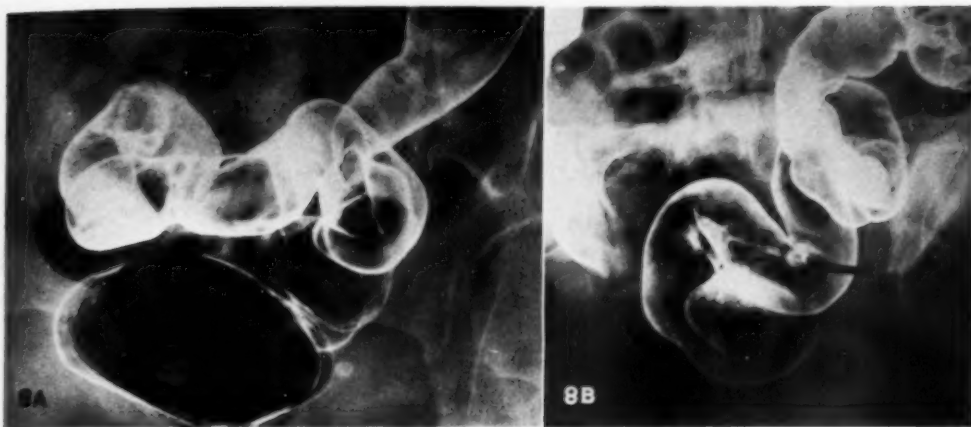


Fig. 8. Case V. A. Evacuation air study of rectum and sigmoid with loops obscured due to "festoon" arrangement.

B. "Sitting position" film clearing some overlying loops and revealing polyp in segment of sigmoid not visualized by other methods.

CASE VI: A 34-year-old white woman was referred for examination of the colon because of increasing constipation and bleeding. She gave a history of intermittent bleeding from the bowel for two years. She had had previous roentgen examinations and proctoscopic examinations, and it was felt that the cause of bleeding was explained by this latter examination. Treatment had resulted in temporary relief. Fluoroscopic examination revealed an obstructing lesion in the sigmoid having the appearance of a carcinoma. This was seen best in oblique projection. A rotation film (Fig. 9A) shows this lesion behind an air-filled loop of sigmoid while a "sitting position" film (Fig. 9B) reveals the entire length of the lesion in full view. Repeated proctosigmoidoscopic examination showed the lower edge at about 25 cm. As it was above the peritoneal reflection, an end-to-end anastomosis was accomplished.

CASE VII: A 62-year-old white man was referred for colon examination, complaining of increased constipation. He denied ever passing blood, either as red or tarry stools. This, according to his physician, was borne out by high values for erythrocytes and hemoglobin. Rectal examination did not reveal any abnormality. Fluoroscopic examination showed an obstructing lesion of the rectosigmoid having the appearance of a carcinoma. Routine anteroposterior (Fig. 10A) and postero-anterior films showed the extent of the lesion only indistinctly. In the "sitting position" (Fig. 10B) the carcinoma was demonstrated in its entire extent very clearly. It was removed by combined abdominoperineal resection.

SUMMARY

1. A brief review of the anatomy of the sigmoid is given with special reference

to the difficulty often experienced in making sure it has been adequately examined.

2. The incidence of both polyps and true carcinoma in this segment of bowel is briefly reviewed, emphasizing the necessity of adequate examination for demonstration of the lesions while they are small enough to be adequately removed to cure the patient.

3. The Chassard-Lapiné position was found to be the best of several positions tried to unfold redundant loops of sigmoid, making possible better examination of certain segments of this portion of the colon. This is referred to as the "sitting position." It was described by Raap as a "position of value in studying the pelvis and its contents," with which I agree.

4. Seven cases are presented showing the advantage of this view as a supplement to those previously reported, for better visualization of the sigmoid and demonstration to better advantage of both gross and obscure lesions of this segment of bowel.

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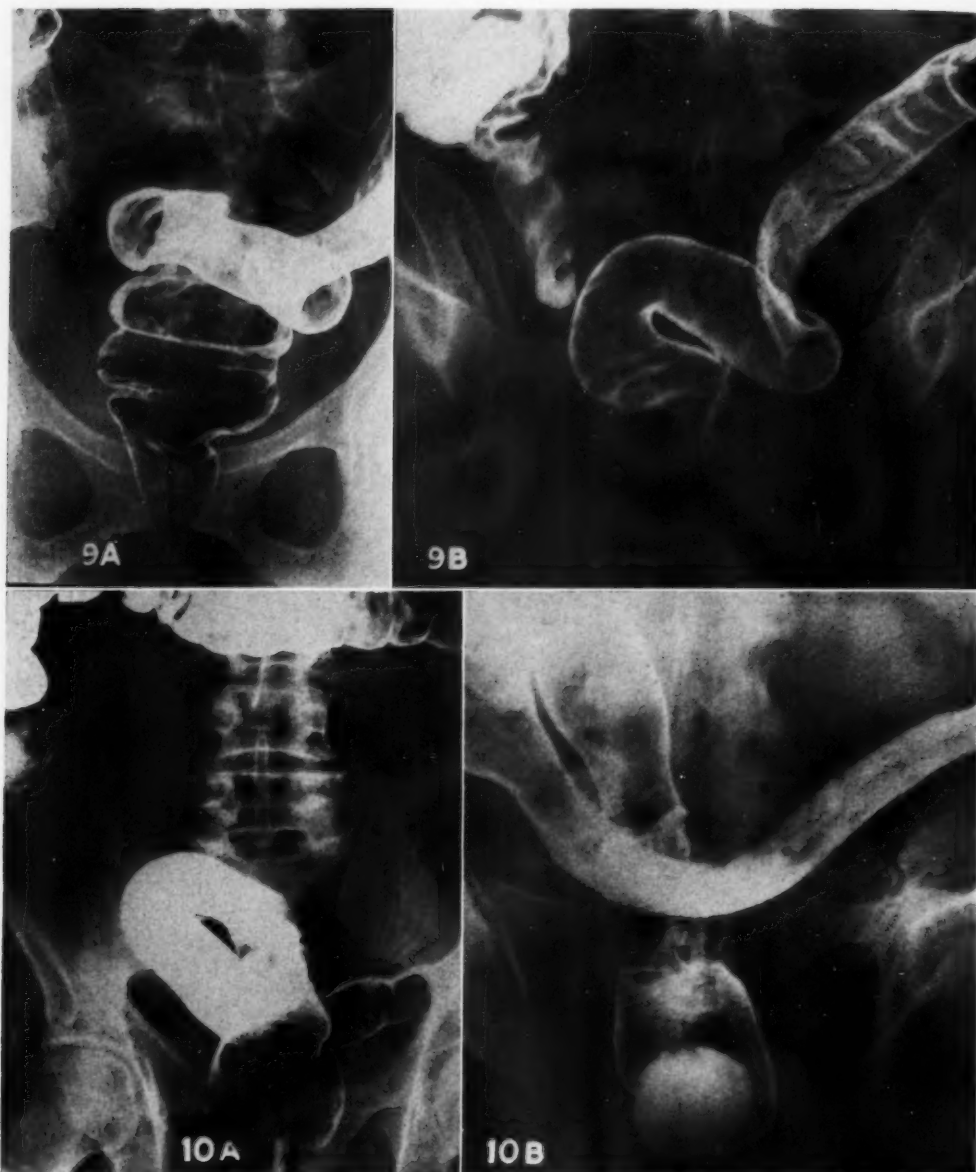


Fig. 9. Case VI. A. Evacuation air study of sigmoid with obstructing carcinoma obscured to great extent by overlying loops.

B. "Sitting position" film showing entire extent of the carcinoma by shifting of the overlying loops.

Fig. 10. Case VII. A. Carcinoma of sigmoid partially obscured by the turn of the involved segment, preventing a clear view in either prone or supine position.

B. "Sitting position" film showing extent of the carcinoma clearly and offering good visualization of the adjacent segment.

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SUMARIO

Examen con Doble Contraste del Colon, con Atención Especial al Estudio de la S Iliaca

La anatomía de la S iliaca hace que resulte sumamente difícil sentirse seguro de que el examen de la misma ha sido adecuado. Debido a esto y a la alta incidencia de lesiones real o potencialmente malignas en la región sigmoidea, se necesita mucho cuidado en los estudios de ella.

Una modificación de la posición de Chassard-Lepiné ha resultado de valor para el examen con contraste doble de la S

iliaca. Se coloca la película en el diafragma de Bucky en ángulo recto al plano medio de la pelvis y el enfermo se sienta en la mesa, inclinándose lo más posible hacia adelante a fin de que el rayo central cruce el raquis y el sacro.

Preséntanse 7 casos que demuestran las ventajas de dicha posición para la visualización de la S iliaca y el descubrimiento de lesiones en esa zona.



Reduction of Ileocecal Intussusception by Hydrostatic Pressure¹

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INTUSSUSCEPTION is the prolapse or invagination of one part of the intestine into an immediately adjoining segment; it occurs most frequently during infancy and early childhood. When the intussusception persists, it produces characteristic clinical signs and symptoms. In the individual case, vomiting, severe intermittent cramp-like abdominal pain, melena, and a palpable sausage-shaped mass within the abdominal cavity may be present. Surgical reduction has long been the treatment of choice in this country. Ravitch (1, 2), a surgeon, has reported successful reduction of ileocecal intussusception by barium enema in selected cases. This simple, safe hydrostatic procedure merits thorough clinical trial.

During the past two years the barium enema has been used routinely at the Children's Hospital of Pittsburgh in the treatment of ileocecal intussusception. This paper describes the details of administration of the enema, discusses criteria for completeness of reduction, and offers suggestions concerning the role of the roentgenologist.

LITERATURE

Ravitch (1) in his first report of 27 cases of intussusception treated by barium enema presented a review of the literature. His two articles (1, 2) should be read by everyone concerned with this problem. Nordentoft (3, 4) and Hellmer (5, 6) have recorded their experiences in the Scandinavian countries, where barium enema has been the treatment of choice in all early cases of intussusception. Hipsley (7, 8), in Australia, also had wide experience with the procedure. It is of interest that

he, a surgeon, adopted the hydrostatic technic in order to decrease the mortality associated with surgery. Ladd and Gross (9) and Gross and Ware (10) reviewed the experience with surgical treatment at the Children's Hospital of Boston. Hydrostatic pressure was not used by them.

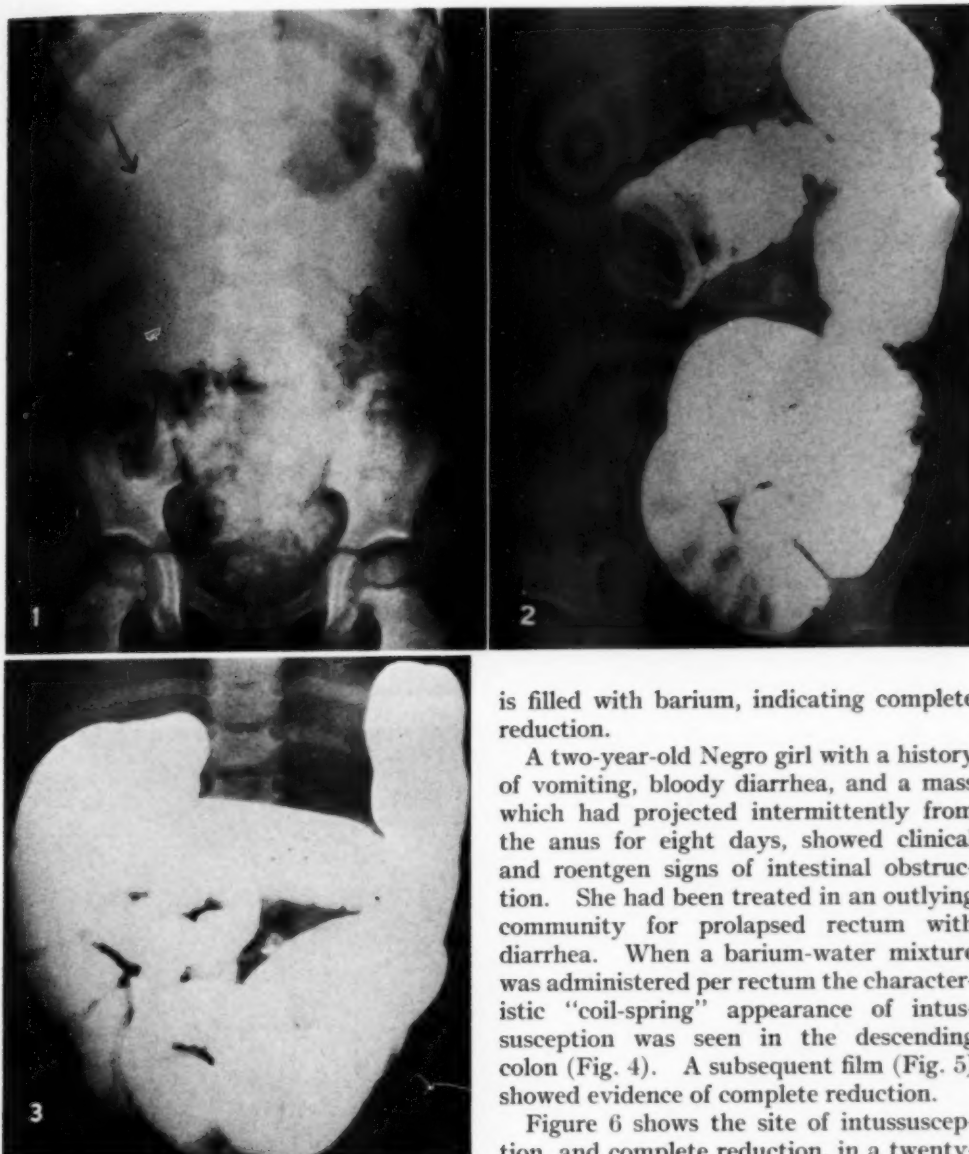
Ravitch concluded that the barium enema should be employed routinely when signs and symptoms are of less than twenty-four hours duration, and he recommended that the procedure be controlled directly by the attending surgeon. He showed experimentally, in animals, that gangrenous intussuscepted bowel was not perforated by the pressure of a column of water 3 feet high, and that intussusception of this type was not reduced by hydrostatic means. The mortality in his series, as well as in those of the Scandinavian and Australian workers using hydrostatic pressure, did not differ significantly from the surgical mortality of Ladd and Gross.

MATERIAL

Intussusceptions in 27 infants ranging in age from three months to three years are included in our series. The duration of their symptoms varied from four hours to eight days. Successful reduction was completed in 22 cases by hydrostatic means.

Figure 1 is the film of the abdomen of a girl of two and one-half years with a history of intermittent abdominal pain and "currant-jelly" stools for four days. A sausage-shaped mass was easily palpated in the right upper quadrant of the abdomen. Air is absent in the bowel in this area; it is significant that there are no roentgenologic signs of intestinal

¹ From the Departments of Pediatrics and Roentgenology of the University of Pittsburgh School of Medicine and the Children's Hospital of Pittsburgh. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7-12, 1952.



Figs. 1, 2, and 3. A preliminary film (Fig. 1) of the abdomen, a spot film (Fig. 2) made after the beginning of the hydrostatic procedure, showing the site of intussusception, and a film showing the evidence of complete reduction (Fig. 3). The patient was a two-and-one-half-year-old girl with a story of intermittent abdominal pain and "currant-jelly" stools of four days duration.

obstruction. Figure 2 shows the filling defect in the proximal transverse colon characteristic of intussusception. In Figure 3 a large segment of terminal ileum

is filled with barium, indicating complete reduction.

A two-year-old Negro girl with a history of vomiting, bloody diarrhea, and a mass which had projected intermittently from the anus for eight days, showed clinical and roentgen signs of intestinal obstruction. She had been treated in an outlying community for prolapsed rectum with diarrhea. When a barium-water mixture was administered per rectum the characteristic "coil-spring" appearance of intussusception was seen in the descending colon (Fig. 4). A subsequent film (Fig. 5) showed evidence of complete reduction.

Figure 6 shows the site of intussusception, and complete reduction, in a twenty-six-month white male. In this case reduction of the intussusception was carried out four hours after the onset of vomiting. Because his father was a physician, the child was returned home immediately following the hydrostatic procedure, without hospitalization. His feeding schedule was not interrupted. He has remained well. We have allowed other children to return home immediately after reduction,

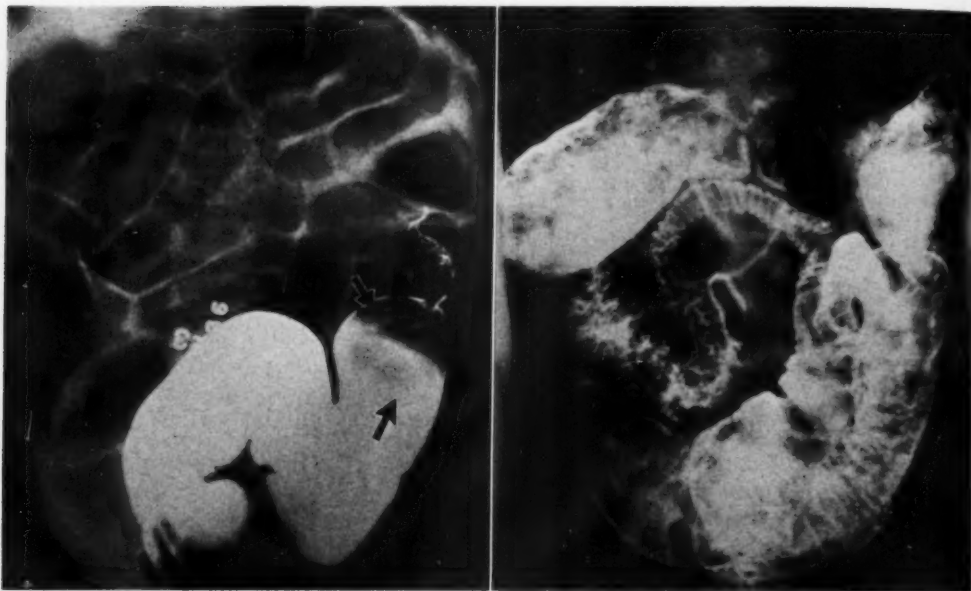


Fig. 4. Filling defect characteristic of intussusception in the distal descending colon of a two-year-old girl who had clinical symptoms for eight days. The dilated loops of bowel indicating intestinal obstruction are also seen.

Fig. 5. A large amount of barium in the dilated ileum indicates complete reduction of the intussusception shown in Fig. 4. The child showed rapid clinical recovery following hydrostatic reduction of the intussusception.

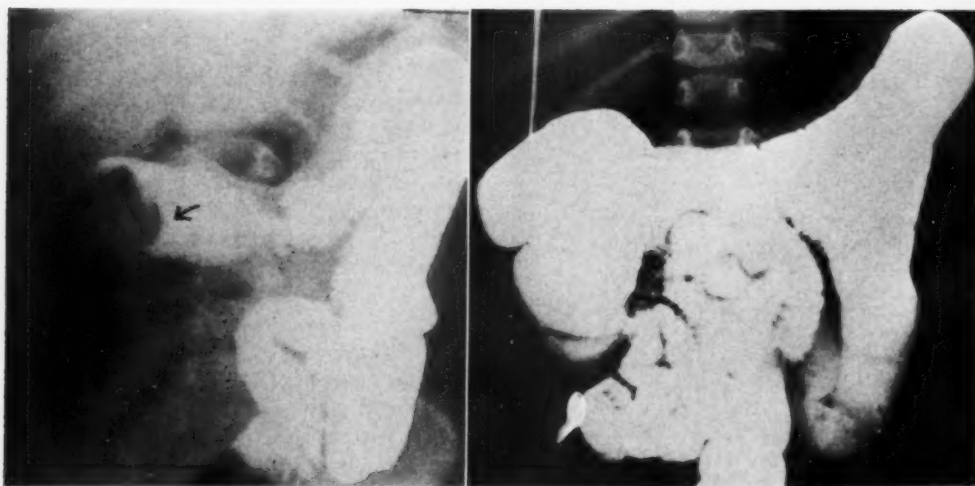


Fig. 6. The film on the left identifies the site of intussusception in a twenty-six-month-old male with vomiting of four hours duration. A mass was palpable in the right upper quadrant of this child's abdomen. On the right, a large portion of ileum is seen filled with barium-water mixture, indicating complete reduction. The child was returned home immediately following hydrostatic reduction of intussusception.

although this is not done in all instances.

Figure 7 shows films of the abdomen and pelvis made after an unsuccessful attempt at hydrostatic reduction of intussusception

in a four-month-old white girl with a three-day history of bloody diarrhea and vomiting. Roentgen signs of ileo-ileal intussusception are present. This infant was

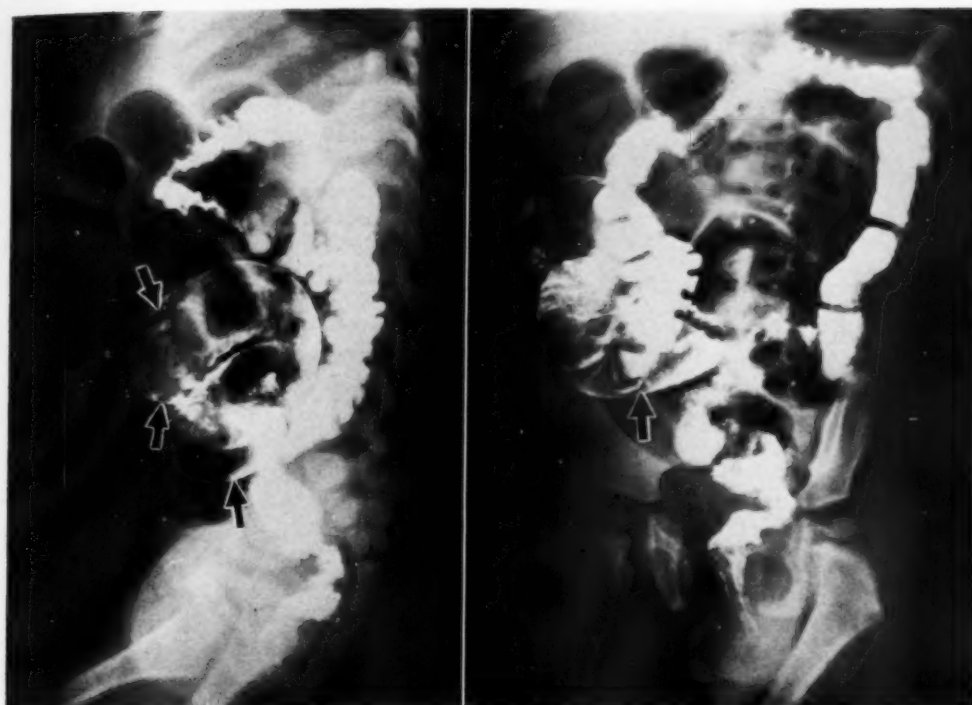


Fig. 7. Lateral and anteroposterior views of the abdomen following administration of barium-water mixture per rectum identify clearly a large ileo-ileal intussusception (see arrows). This infant had a three-day history of blood in the stools and vomiting. The intussusception did not extend into the cecum. Surgical resection of gangrenous ileum was carried out successfully.

explored surgically, and the gangrenous bowel of an ileo-ileal intussusception resected successfully.

In 3 instances reduction of an ileocecal intussusception could not be accomplished by hydrostatic means, and flow of barium into the ileum was not obtained. The patients were immediately explored surgically and reduction was completed. These 3 patients were similar clinically and roentgenographically to the others, who responded satisfactorily to hydrostatic pressure. The cause for the failure of "pressure" treatment was not evident on direct inspection and manipulation after laparotomy. Since the cases were all seen in the first six months of our study, it seems probable that our earlier inexperience was largely responsible for the failures.

One child, with a three-day history of vomiting, was admitted in critical condi-

tion; hydrostatic treatment was begun at the surgeon's request. Reduction was completed, but convulsions ensued while the patient was still on the fluoroscopic table. He died the following day. In Figure 8 the barium mixture in the markedly dilated small bowel of this infant demonstrates complete reduction of the intussusception. At necropsy, also, it was clear that the intussusception had been fully reduced and the bowel was not gangrenous.

In summary, of 27 infants with intussusception, 22 were successfully treated by retrograde hydrostatic pressure. There was one death. In 4 instances surgery was necessary to complete reduction. In 1 of the latter, the intussusception was ileo-ileal in type and gangrenous bowel was resected.

METHOD

If the hydrostatic treatment of intus-

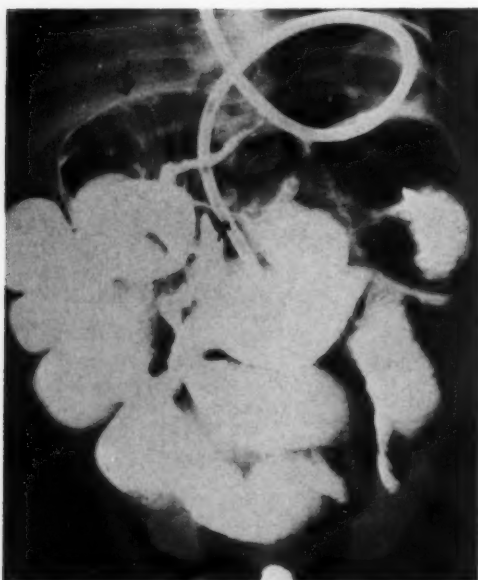


Fig. 8. Film of the abdomen made following hydrostatic reduction of intussusception in a critically ill infant. Barium-water mixture in the markedly dilated ileum indicates complete reduction of intussusception. Convulsions occurred while the child was on the fluoroscopic table. He died the following day. At necropsy it was clear that the intussusception had been completely reduced and that the bowel was not gangrenous. Death was presumed to be due to irreversible electrolytic disturbances, aspiration pneumonia, and peritonitis.

susception is to be successful in infants and younger children, two basic conditions must be met. First, the patient must be under control physically at all times and the enema must be retained until the examination has been completed. Second, neither the examiners nor the patient must be unduly exposed to radiation.

Figure 9 shows the equipment used in the hydrostatic procedure. The 6-inch non-elastic ("ace") bandage is wrapped around the lower extremities. An appropriate width and length of stockinette is pulled over the arms, and heavy sandbags are placed on either side of the body. An ungreased Bardex catheter, child's size, is inserted into the rectum and the bag is inflated. The patient is turned on his side, and long strips of adhesive tape are drawn tightly across the buttocks to keep them in apposition. This eliminates the need of an assistant's hand in the

field of direct radiation to pinch the buttocks. The patient with suspect intussusception has usually been subject to repeated digital examination of the rectum. The combination of ungreased Bardex tube and taped buttocks assures retention of the barium solution.

The immobilized infant prepared for examination is shown in Figure 10. A compression band may be drawn across the thighs of the older patient (Fig. 11) to

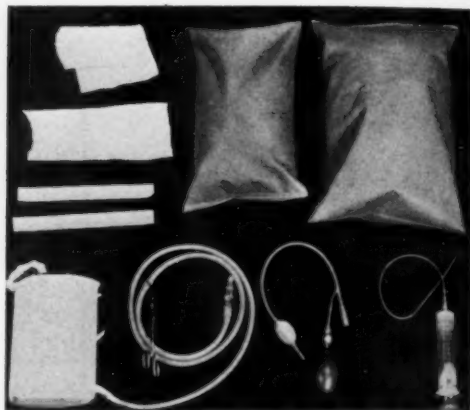


Fig. 9. Equipment used during the hydrostatic treatment of intussusception. In the upper left hand portion of the picture 6-inch roller bandage, stockinette, and long strips of adhesive tape are seen. The large sandbags each weigh 25 pounds or more. The enema can in the lower left hand corner is standard. The child's size Bardex rectal tube, and a 50-c.c. syringe with a gastric gavage tube are shown in the lower right hand corner.

obtain satisfactory immobilization. The enema can is placed 3 feet above the table top. When preparations are complete, the examiner is ready to begin the procedure (Fig. 12).

The immobilized infant is usually quiet and often sleeps during the intervals between recurrent colicky abdominal pains. The described method of immobilization, in whole or in part, is useful in many types of roentgen examination of infants and children, and in many non-roentgenologic pediatric procedures.

Before the barium-water mixture is introduced into the rectum, a tube is passed into the stomach and the gastric contents are aspirated. In the infant who

has been vomiting, this lessens the possibility of aspiration during the hydrostatic procedure.

Under fluoroscopic observation, a thin barium-water mixture is introduced into the colon and its progress is followed. Manual palpation to aid in the reduction has been used by the Scandinavians with good results and without harm to the patient. Ravitch is strongly opposed to this procedure. Although heavy palpa-



Fig. 10. Infant immobilized according to the methods described in the text. A roller bandage has been drawn around the lower extremities, stockinette has been pulled over the arms, and heavy sandbags have been placed on either side. A child's size Bardex rectal tube has been placed in the rectum. The enema can is held 3 feet above table level.

Fig. 11. Compression band drawn across the lower extremities.

tion is to be avoided, in our experience reasonably gentle manipulation has not been injurious.

Criteria for Completeness of Reduction: After the head of the intussusception has



Fig. 12. The examiner ready to begin the procedure, with the infant under direct positive control.

been encountered, a filling defect appears in the barium column. The barium mixture then advances toward the ileocecal valve. Spot films may be made as indicated for the records, and for later study. Reduction is considered complete when the barium flows freely through the ileocecal valve into the terminal ileum. When flow of the barium mixture into the ileum is delayed, the hydrostatic treatment is usually continued for ten minutes. During this period fluoroscopic observations are made at short intervals.

If barium has not entered the ileum at the end of ten minutes, the child is encouraged to empty the colon. Defecation itself may cause backflow into the terminal ileum when this has not occurred during the earlier phases of the examination with high artificially induced pressure. If retrograde flow of the barium-water mixture into the ileum does not take place during defecation, the hydrostatic pressure method is again applied.

In a small percentage of asymptomatic individuals, retrograde flow into the ileum



Fig. 13. A large filling defect (see arrow) at the ileocecal valve following barium meal. This child had complete reduction of ileocecal intussusception twenty-four hours earlier by hydrostatic means and was asymptomatic at the time of this examination. The filling defect at the ileocecal valve is almost certainly due to residual edema of the mucosa in this area.

during standard barium enema cannot be obtained. Therefore, failure of reflux in the child with intussusception does not necessarily imply incompleteness of reduction. In the absence of good flow, however, the examiner must freely assert that the most conclusive roentgen sign of complete reduction is lacking.

When the ileum is not filled, the clinical condition of the patient is evaluated. If he is asymptomatic and comfortable, and if a mass is no longer palpable, then it is reasonable to wait for a short period before the decision to treat surgically is made. This decision must be made finally by the attending surgeon after the radiologist has decided that hydrostatic pressure has failed. When the patient's clinical condition indicates that reduction has probably been completed, a waiting period of eight to twelve hours is recommended before this decision concerning surgery is reached.

A large filling defect at the ileocecal valve suggesting incomplete reduction may be due to residual edema of the mucosa in this area. Here, too, the decision concerning completeness of reduction depends

on clinical findings. Figure 13 shows such a filling defect following a barium meal in a child whose clinical course indicated that reduction had been successful. Identical filling defects in the cecal lumen at the site of the ileocecal valve have been seen on barium enema studies done seven days following successful surgical reduction of intussusception. These patients had long since fully recovered clinically.

If signs of intestinal obstruction persist after hydrostatic reduction, surgical treatment should be instituted. Films of the abdomen made eight to twelve hours after the enema will be found useful for evaluation of persistence of intestinal obstruction. This method is more convenient and informative than the recovery in the stools of charcoal administered by gastric gavage.

DISCUSSION

It is not the primary purpose of this paper to argue the merits of hydrostatic reduction of intussusception as opposed to the surgical approach. There are obvious advantages of a non-surgical solution to any problem in terms of patient comfort, morbidity, and expense.

Three theoretical objections to hydrostatic reduction are the possibility of perforation of the bowel, possible recurrence of the intussusception, and failure of identification of a lead point. These objections have been well discussed and refuted by Ravitch. Perforation due to the low pressure generated by a column of barium-water mixture 3 feet high, or reduction of intussusception in gangrenous bowel by such pressure, is a remote possibility. Available data show that the recurrence rate is identical in reduction by surgical treatment and by hydrostatic pressure. Ileocecal intussusception occurs most frequently in patients three months to two years of age; lead points are found in less than 5 per cent of infants in this age group.

Because of the advantages of hydrostatic reduction, it is probable that this procedure will gradually become the method of choice in the reduction of ileocecal intus-

susception in this country, as it has been in Scandinavia for many years. The roentgenologist, therefore, will be more concerned with the problem. His responsibilities in this respect must be established.

Ravitch insists that the reduction of intussusception by hydrostatic pressure is a surgical procedure and should be under direct surgical supervision. This may be desirable in institutions where one or two surgeons see all cases of intussusception. Usually, however, many surgeons and pediatricians are concerned, but no one surgeon sees a sufficient number of cases to become expert in hydrostatic reduction. Under these circumstances, it is logical that the roentgenologist should become fully acquainted with all the clinical aspects of intussusception and expert in the technic and evaluation of hydrostatic reduction. In a given hospital he will see every suspect case. With the surgeon, he must be prepared to assume responsibility for its diagnosis and first treatment by non-surgical means. He must be alert to concede failure of hydrostatic reduction when this becomes evident. He should be consulted regarding indications for, and advisability of, the procedure in individual cases.

Most advocates of the hydrostatic reduction of intussusception do not recommend that the method be attempted when symptoms have been present for twelve, twenty-four, or thirty-six hours. Our figures indicate that this time factor, by itself, is not valid, and that successful reduction may be carried out with hydrostatic pressure at almost any time that the child's clinical condition permits. Intussusception often is a dynamic condition in which spontaneous and frequent remissions and exacerbations occur.

When signs of intestinal obstruction and shock are present, any method of reduction should be used with caution. Dehydration and shock must be treated first. If the enema is then administered, it should be with the knowledge that it may prove unsuccessful and that it will be

abandoned if reduction does not follow easily and promptly. The surgeon is properly present in such instances, and the operating room is alerted to the possibility of immediate surgery. Manifest signs of peritonitis are indications for surgical treatment.

The roentgenologist, if he is acquainted with the clinical problem of intussusception, and if hydrostatic reduction is readily managed with effective methods of restraint and immobilization similar to those outlined above, can treat most cases of intussusception successfully without surgical intervention. Pediatricians will, it is probable, eventually refer patients with intussusception directly to the radiologist for confirmatory roentgen diagnosis and hydrostatic reduction, as in Scandinavia. Currently the surgeon should be consulted from the start, and the indications for the procedure discussed with him. The radiologist should be prompt to concede failure of reduction or inadequate reduction.

Under these circumstances both hydrostatic reduction and surgical reduction will receive optimal consideration and use. If the radiologist is not informed concerning the technic of hydrostatic reduction and proper immobilization of the patient, if he is not aware of the clinical and roentgen signs of completeness of reduction, and if he is not fully acquainted with the entire clinical problem, he should play a secondary role and carry out the instructions of the surgeon, who, under these circumstances, should make all important decisions.

SUMMARY AND CONCLUSIONS

1. Data regarding the usefulness of hydrostatic pressure with barium enema in the reduction of intussusception have been presented. A technic of immobilization and enema administration has been described.

2. The results of reduction of ileocecal intussusception by hydrostatic pressure, as used routinely at the Children's Hospital of Pittsburgh, have been given. Although the method was regarded by the surgeons

with skepticism when it was introduced two years ago, the results have been so encouraging that it is now their treatment of choice. In two years 27 patients have been treated. In 22, complete reduction was obtained. In 3 instances of ileocecal intussusception, reduction had to be completed at surgery. One seriously ill infant whose intussusception had been completely reduced by hydrostatic means died one day later. One child with pure ileo-ileal intussusception of three days duration required surgical resection of a gangrenous portion of bowel.

3. Hydrostatic pressure by barium enema, properly used, is the treatment of choice of ileocecal intussusception in infants and young children. The limitations of its use are not defined; our results suggest that long duration of symptoms does not necessarily contraindicate first attempts at reduction by hydrostatic pressure. Indications are that pediatricians and surgeons alike, impressed with the ease and safety of the hydrostatic method, will seek its wider use.

4. The roentgenologist must be more than the intermediary technician when the hydrostatic method of reduction of intus-

susception is adopted. Where surgeon and radiologist co-operate fully, the technic will find increasing use and usefulness.

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SUMARIO

Reducción de la Invaginación Íleocecal por la Presión Hidrostática

Debidamente usada, la presión hidrostática con un enema de bario es el tratamiento de elección en la invaginación íleocecal en los lactantes y los niños. Preséntase una serie de 27 casos tratados con este método. La reducción de la intussuscepción fué un éxito en 22 casos. Hubo una muerte. En 3 casos, la cirugía resultó necesaria para completar la reducción y un niño que tenía una invaginación íleoileal pura de 3 días de duración requirió la resección quirúrgica de una porción gangrenada del intestino.

Descríbese la técnica para inmovilizar al enfermo e introducir la mezcla de bario-agua del enema. Considérase la reducción como completa cuando el bario pasa sin obstáculo a través de la válvula

íleocecal a la porción terminal del íleon.

El radiólogo debe familiarizarse por completo con todos los aspectos clínicos de la invaginación y adiestrarse en la técnica y la justipreciación de la reducción hidrostática. Junto con el cirujano, debe estar preparado para tomar la responsabilidad del diagnóstico del proceso y del tratamiento inicial del mismo por medios incruentos. Debe estar sobre aviso para admitir el fracaso de la reducción hidrostática cuando esto se vuelve evidente. A su vez, debe ser consultado en cuanto a las indicaciones y la conveniencia del procedimiento en casos dados. Cuando el cirujano y el radiólogo cooperan sinceramente, esta técnica resultará cada vez de mayor utilidad.

The Detection of Early Carcinoma of the Stomach

An Evaluation of the Roentgen Examination of the Patient with Gastrointestinal Symptoms¹

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IT HAS BECOME increasingly clear in the past decade that, in order to improve the results of therapy for carcinoma of the stomach, early diagnosis is essential. The treatment of this condition, which is entirely surgical, has advanced greatly with the improvement in surgical technics and in preoperative and postoperative care. Advances in surgery are of no avail, how-

ever, when the surgeon is confronted with extensive disease. Recently a good deal of effort has been directed toward the problem of early diagnosis in gastric carcinoma. Table I shows the results obtained in several surveys of groups in which carcinoma was unsuspected. St. John *et al.* (6) surveyed 2,413 asymptomatic persons over the age of fifty. Their method comprised preliminary fluoroscopy supplemented by films when the fluoroscopic findings suggested the necessity for a more complete examination. Two gastric cancers were discovered in this fashion. Dailey and Miller (2)

examined 500 asymptomatic males over the age of forty-five. Their methods were much the same as those described above. No malignant lesions were discovered in this group. Rigler and State, and their associates (4, 7) examined 1,544 persons over fifty years of age without symptoms, with achlorhydria or low total acid. The method of examination employed by these

TABLE I: COMPARISON OF METHODS AND FINDINGS OF VARIOUS SURVEYS FOR THE DETECTION OF CARCINOMA OF THE STOMACH

Authors	Patients Examined	Method	No. of Patients	Carcinoma Discovered			Polyps Discovered
				Total	Late	Early	
St. John, Swenson and Harvey (6)	Asymptomatic; over 50 years	Fluoroscopy; films when indicated	2,413	2	0	2	1
Dailey and Miller (2)	Asymptomatic males; over 45 years	Fluoroscopy; films when indicated	500	0	0	0	1
Rigler (4); State <i>et al.</i> (7)	Asymptomatic; over 50 years; low or absent HCl	Routine fluoroscopy and films	1,544	11	4	7	42
Morgan's group (3, 5)	Consecutive admissions to clinic; over 45 years	Photofluorography; routine examination when indicated	6,000	23	?	?	?
Present series: University Hospitals of Cleveland	Symptomatic; 15 to 96 years	Routine fluoroscopy and films	3,680	31	25	6	4

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investigators was the usual routine of fluoroscopy and numerous films. Eleven gastric carcinomas were found. The series reported by Roach, Sloan and Morgan (3, 5) consisted of 6,000 consecutive admissions to their Out-Patient Clinic without regard to symptoms. Most of the patients in this group were in the older age range. The method of study employed by these investigators was photofluorography followed by a routine gastrointestinal examination if indicated. The survey disclosed the presence of 23 lesions later proved to be carcinoma of the stomach.

In order to evaluate our own material

¹ From the Department of Radiology, University Hospitals of Cleveland, and Western Reserve University School of Medicine. Accepted for publication in April 1952.

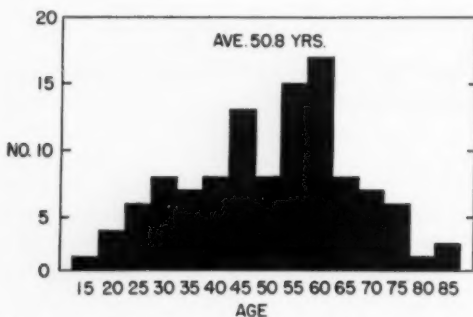


Fig. 1. Age distribution of 100 symptomatic patients who had negative upper gastrointestinal examinations.

and to examine the premises upon which one might base an attack on the problem of early detection of carcinoma by x-ray, a review of 3,680 consecutive gastrointestinal examinations was made. The patients ranged in age from fifteen to ninety-six years. The cases in which carcinoma was diagnosed were intensively studied. It must be emphasized that the examinations which comprise this series were conducted upon patients who were referred for x-ray studies because of definite gastrointestinal symptoms. Very few examinations were of the survey type. It seemed not unreasonable that this material might elucidate the advisability of surveying only those who had symptoms ref-

erable to the upper gastrointestinal tract. It was also possible to study the symptoms and findings leading to the x-ray examination.

As may be seen from our data (Table II), 65 per cent of the 3,680 examinations were negative. There were 82 gastric ulcers

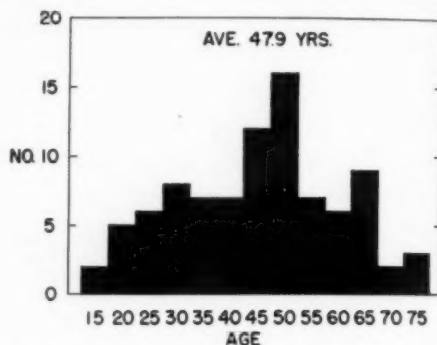


Fig. 2. Age distribution of 100 patients with radiologically proved duodenal ulcer.

TABLE II: SUMMARY OF LESIONS FOUND BY ROUTINE UPPER GASTROINTESTINAL STUDY OF 3,680 CONSECUTIVE SYMPTOMATIC PATIENTS

Total examinations.....	3,680
Negative examinations, including unsatisfactory and doubtful examinations.....	2,375(65.0%)
Lesions of the stomach (non-neoplastic)	
Benign gastric ulcer (82) or ulcer scar (10).....	92(2.5%)
Diaphragmatic hernia.....	150(4.1%)
Miscellaneous: postoperative, gastritis, ptosis, etc.....	285(7.8%)
Lesions of the stomach (neoplastic) (43 diagnosed)	
Carcinoma.....	35(0.9%)
Lymphosarcoma.....	1
Polypi.....	4
Erroneous diagnoses of carcinoma.....	3
Lesions of the duodenum	
Ulcer or ulcer deformities.....	581(15.8%)
Neoplasms.....	3(0.08%)
Miscellaneous: pressure defects, etc.,	38
Lesions of the esophagus	
Carcinoma.....	5(0.13%)
Diverticula.....	33
Varices.....	9
Miscellaneous: cardiospasm, stricture, ulcer, foreign bodies, etc.....	69

and 10 additional ulcer scars due to known gastric ulcers (comprising together 2.5 per cent of the total). Duodenal ulcers numbered 581, representing approximately 17 per cent of the cases examined. In 43 cases neoplastic lesions of the stomach were diagnosed (or 1.2 per cent of all patients examined). Thirty-five of these were clear-cut carcinoma as demonstrated roentgenologically, and 31 of the 35 were proved by operation and postmortem examination. The remaining 4 patients were not explored but the diagnosis of carcinoma is considered radiologically secure. There was one case of lymphosarcoma and there were 4 benign polyps. In 3 cases the diagnosis of cancer was erroneous. It is clear, therefore, that in a group of patients having epigastric symptoms, carcinoma of the stomach is an infrequent finding.

The age distribution of 100 patients with upper gastrointestinal symptoms but negative x-ray studies is shown in Figure 1, the average being 50.8 years. The average age of 100 patients with duodenal ulcer, proved radiologically, was 47.9 years (Fig. 2). The 82 patients with benign gastric ulcer had an average age of 53.5 years (Fig. 3), and the 35 individuals with car-

cinoma of the stomach an average age of 63.5 years (Fig. 4). There is probably no significant difference between the age of the symptomatic patient whose stomach is found to be radiographically normal and that of the patient with duodenal or gastric ulcer. The age of the patient who has

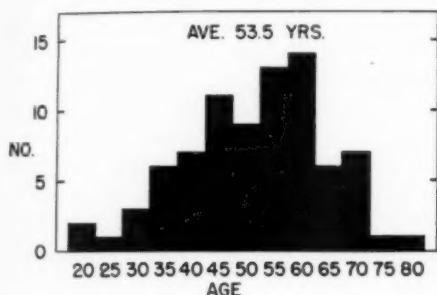


Fig. 3. Age distribution of 82 patients with radiologically proved gastric ulcer.

carcinoma of the stomach, however, is clearly higher. It will be noted in Figure 4 that only 2 cases occurred under the age of fifty. One of these was an early carcinoma.

In order to determine what symptoms should lead the clinician to examine for cancer of the stomach, the charts of 100 patients with upper gastrointestinal symptoms but radiographically negative stomachs were studied and their symptoms and clinical findings were compared with those of the carcinoma group. There appeared to be a somewhat higher incidence of nausea, vomiting, upper abdominal pain, melena, and hematemesis in the patients with carcinoma (Table III). These differences might not be specifically significant. Sixty-three per cent of persons with carcinoma complained of weight loss; achlorhydria and anemia were found in 60 per cent. Accurate figures for achlorhydria and anemia in the normal group were not available.

In order to decide if symptoms furnished any indication as to the extent of neoplasms of the stomach, cases were graded 1, 2, 3, and 4+ according to surgical findings; 4+ represented involvement of three-fourths of the stomach or more, with ex-

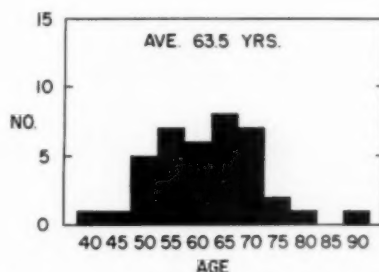


Fig. 4. Age distribution of 35 patients with radiologically certain carcinoma of the stomach (31 proved by operation).

TABLE III: COMPARISON OF SYMPTOMS AND CLINICAL FINDINGS IN 35 PATIENTS WITH A RADIOLOGIC DIAGNOSIS OF CARCINOMA OF THE STOMACH WITH THOSE OF 100 WITH RADIOLOGICALLY NEGATIVE UPPER GASTROINTESTINAL TRACTS

	(100) Normal Stomach	(35) Carcinoma of Stomach
Nausea	39%	50%
Vomiting	28%	45%
Ulcer pain	16%	17%
Other pain	53%	80%
History of melena	9%	17%
History of hematemesis	3%	11%
Weight loss	19%	63%
Achlorhydria		60%
Anemia		60%
Age of patient	50.8	63.5

tensive infiltration and metastases; 3+ represented extensive infiltration with involvement of half or two-thirds of the stomach; 2+ indicated involvement of about one-fourth of the stomach; 1+ indicated relatively small lesions, none of which showed metastases. All those cases classified as 3 and 4+, together with all but 2 of the cases in the 2+ group, could be considered far advanced. In these, metastases were found. The 2 remaining cases in the 2+ category represented fairly large tumors in which no metastases could be demonstrated. Therefore, only 6 out of 35 cases qualified as surgically early.

Of interest is the comparison of the severity of symptoms. Symptoms, which are always difficult to classify, were graded as 1, 2, 3, and 4+, and a scatter diagram was made in which each case is pinpointed according to size and symptomatology (Fig. 5). It may be seen that the disease was generally more extensive than the

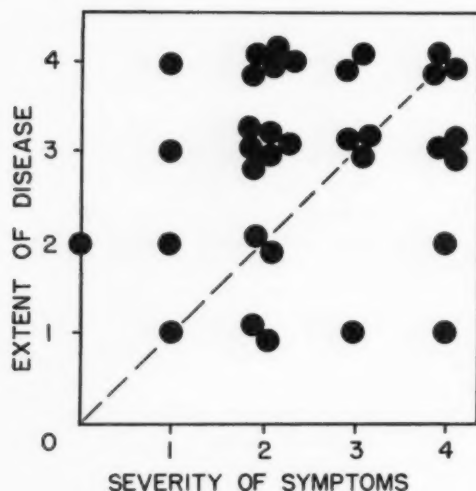


Fig. 5. Scatter diagram of 31 surgically proved cases of carcinoma in which severity of symptoms is compared with extent of disease.

severity of symptoms might indicate. In a few cases, the symptoms were more severe than the extent of the lesion but these represent not more than 20 per cent of the total number.

The types of lesions which were discovered in the stomach are of interest, but perhaps not pertinent here. Half of them were polypoid carcinoma. The remainder were divided among the annular, scirrhous, infiltrative and ulcerative varieties.

DISCUSSION

If we re-examine Table I with special reference to the right hand columns and consider the number of early carcinomas discovered by the various survey methods, it is apparent that survey of asymptomatic patients over the age of forty-five or fifty, as was done by St. John, Swenson, and Harvey and by Dailey and Miller, produced a very low return. St. John *et al.* detected 2 small carcinomas and 1 polyp. It is safe to consider the polyp a premalignant lesion, as does Rigler. Dailey and Miller discovered no tumors which were malignant and found but 1 polyp. Morgan reported 23 neoplasms but does not discuss their size. No mention is made of polyp. The work of Rigler and State is

somewhat more encouraging: of 11 carcinomas, 7 were small, and, in addition, 42 polyps were described. In our own series of examinations, only 6 of 35 cancerous lesions were small and but 4 polyps were discovered.

It must be pointed out that the series of cases reported in this paper is not a large one and that statistically secure conclusions are not to be drawn. The salient features of the problem, however, are clearly apparent. This study indicates that a survey of symptomatic patients of all ages by routine fluoroscopic and film methods would yield a higher return of positive diagnoses of carcinoma of the stomach. Unfortunately most of the lesions thus discovered would be late ones. It has long been known, but must again be emphasized, that symptoms of carcinoma of the stomach are not proportional to the extent of disease. It is ironic to note that a large number of patients with no radiographically demonstrable disease presented complaints similar to those of patients with so serious an affliction as carcinoma.

From the point of view of clinical findings, the most striking features in persons with cancer of the stomach are: greater age, more extensive weight loss, anemia, and absent or low gastric acidity. Weight loss and anemia might well be the result of advanced disease. Low gastric acidity has been used as an indication for survey, although we found this condition in but 8 of 12 patients. Figures on the occurrence of low free acidity in cancer of the stomach vary somewhat—from 70 per cent (1) to 86 per cent (7)—depending on the institution and the method employed. Any survey which excluded persons with normal acidity might, therefore, miss a small number of neoplasms.

A survey of all persons over the age of forty, regardless of symptoms and clinical findings, would seem to be the method most likely to discover the asymptomatic early carcinomas as well as the symptomatic ones, both early and far-advanced. The prospect of such a venture, even employing the preliminary photofluorographic

screening technic of Roach, Sloan and Morgan (5) is most forbidding. It would require the formation of large associations of physicians and would need vast organization and financial support, and would doubtless have widespread sociological implications.

Morgan presents yet another point relative to the discovery of serious disease in the asymptomatic patient. He points out that 23 patients with carcinoma have been operated upon by his group, but only one of these patients was asymptomatic. Cancer has been diagnosed radiographically in an additional 13 persons, most of whom are without symptoms arising from the upper gastrointestinal tract. These patients have refused operation, and Morgan states that they doubtless will not consent to surgery until symptoms are present and, as we have seen, the disease is extensive. Education of the patient might be expected to ameliorate this phase of the problem.

Thus the entire matter of survey for the detection of early cancer of the stomach by the radiographic technic available is a difficult if not a discouraging one, and the resolution of this problem may lie in other directions.

SUMMARY

1. Roentgen examination of 3,680 pa-

tients with symptoms apparently arising from the upper gastrointestinal tract disclosed 35 cases of carcinoma. Most of these were advanced.

2. Patients with carcinoma of the stomach, as compared with those having other gastrointestinal lesions, showed a more advanced age, more extensive weight loss and anemia, and low or absent gastric acidity. The disease was generally more extensive than the clinical symptoms would indicate, but this was not invariably true.

3. The data have been studied for indications which might lead to earlier detection of carcinoma of the stomach.

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SUMARIO

El Descubrimiento del Carcinoma Incipiente del Estómago: Justipreciación del Examen Roentgenológico del Enfermo que Tiene Síntomas Gastrointestinales

Tratando de determinar las premisas desde las cuales podría abordarse el problema del descubrimiento radiológico temprano del carcinoma gástrico, se hizo un repaso de 3,680 exámenes consecutivos de enfermos que presentaban síntomas gastrointestinales. La serie reveló 35 casos de carcinoma, casi todos los cuales eran avanzados.

Observóse que los sujetos que tenían carcinoma del estómago eran en general algo más viejos que los que padecían de

otras lesiones gastrointestinales. También mostraron más pérdida de peso y anemia e hipo- o anaclorhidria. La enfermedad era generalmente más extensa de lo que indicaban los síntomas clínicos, pero esto no sucedió invariablemente.

Parece que un examen de todas las personas de más de 40 años, independientemente de los síntomas presentes, sería el método más susceptible de descubrir los carcinomas incipientes asintomáticos del estómago a la par que los sintomáticos.

Annular Pancreas¹

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ANNULAR PANCREAS is an interesting anomaly, the rarity of which has received adequate attention in the literature. In view of its strategic position, encircling the second portion of the duodenum, the infrequency of its identification during life is particularly remarkable. By this level pass all ingested food and fluids, and into this segment of the bowel are emptied the products of the liver, gallbladder, and pancreas.

That the development of the pancreas may be somewhat haphazard, or at least irregular, is evidenced by the frequent finding of ectopic islands of pancreatic tissue in other nearby organs, notably the duodenal and gastric walls, and by the multiplicity of abnormal types of duct formation and their diverse points of entry into the duodenum and even into the stomach (1).

According to embryologists, the human pancreas arises as two entodermal outgrowths, the dorsal and ventral anlagen. The dorsal extends out from the posterior wall of the intestinal tube just proximal to the common bile duct. From this is formed all of the pancreas except a section of the head. The ventral anlage, from which the latter arises at first consists of two buds—a right and a left. The left normally atrophies quite early in embryonic life. As the intestine develops and rotates, it carries with it the ventral anlage and this ultimately fuses with the dorsal. The duct systems in the two sections also unite. The dorsal anlage provides the duct of the body, tail, and part of the head, while the remainder is derived from the ventral.

It is obvious that any failure or delay in the development or rotation of the gut and its accompaniments may cause some type of anomaly. As Lehman (2) suggests,

failure of the left bud of the ventral anlage to atrophy may be a cause of serious developmental irregularity. Dozzi (3) also considers this a likely possibility.

In 1933, a complete review of the literature on annular pancreas was presented by McNaught (4), who by the inclusion of a case of his own brought the total number of recorded examples to 40. Two years later, with Cox (5), he reported a second case and added 3 more from the literature. In 1942, Lehman (2) brought the list up to 49, including a case of his own. Reports by Chapman and Mossman (6), Stofor (7), Gross and Chisholm (8), Custer and Waugh (9), Goldyne and Carlson (10), Nedelec (11), Brown, Bingham, and Cronk (12), Burger and Alrich (13), Ohlmacher and Marshall (14), Ravitch and Woods (15), Conroy and Woelfel (16), Haden (17), Bickford and Williamson (18), Anderson and Wapshaw (19), Payne (20), and Baker and Wilhelm (21) had brought the total by the end of 1951 to over 60.

Anatomy: An annular process of pancreatic tissue extends from the head of the pancreas and encircles the duodenum as a thick band. Sometimes the ring is not quite complete on the anterior aspect (19). This variation is uncommon and is, of course, less constricting than complete encirclement. In nearly every instance there is a greater or lesser degree of narrowing of the duodenal lumen, sometimes to the extent of nearly complete obstruction. The annular pancreatic band consists of normal pancreatic tissue and has a drainage system which usually empties into the main pancreatic duct. Cunningham (23) has noted, however, that this is not always so. Sometimes the pancreatic anomaly and duodenal tissues are very adherent, fused to some extent, and surgically inseparable.

Clinical Observations: Since about two-thirds of the cases have been found at

¹ Accepted for publication in May 1952.

routine postmortem examination, it would seem that symptoms are not outstanding. When they are present, however, they may be quite distressing. Signs of bowel obstruction are most frequent, but ulceration and hematemesis also occur. One case of acute pancreatitis of the aberrant tissue has been reported (24).



Fig. 1. Original roentgenogram showing the narrowed lumen of the second portion of the duodenum.

Diagnosis: Obviously, clinical findings alone cannot establish the diagnosis of annular pancreas. Roentgenologic studies afford the only sure means of identification. In Lehman's case and also in Payne's a definite preoperative diagnosis was made. If repeated studies over several months are possible before operation, the unchanging character and size of the duodenal lumen seem to be important diagnostic features.

The rarity of the condition is in itself the greatest single factor in its non-recognition. Even at laparotomy, lack of consideration may prejudice diagnosis.

Treatment: Some type of surgery—division of the annulus or some form of bowel short-circuiting operation—is required for lasting relief. Each of these procedures has its champions. Because of the inti-

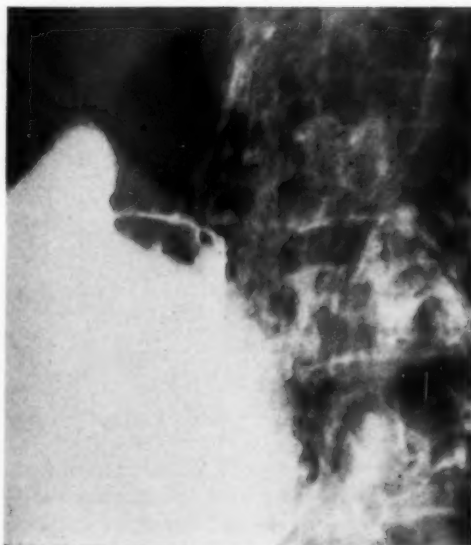


Fig. 2. Roentgenogram made seven months after that in Fig. 1. The appearance of the duodenum is unchanged.

mate connection between bowel and pancreas in many instances, a short-circuiting operation appears to be the general though not exclusive choice.

CASE REPORT

A 62-year-old man presented himself for roentgen examination in April 1951. He appeared thin and undernourished and complained of loss of weight, anorexia, and vomiting, the latter occurring once or twice daily, with no noticeable blood content. There was no clinical evidence of jaundice.

Roentgen examination revealed a large food residue, although there had been no food consumption for about fourteen hours. A nearly complete obstruction in the second section of the duodenum was observed (Fig. 1). The stomach was enlarged and hypotonic. Although the patient was small, positioning to obtain good radiographs of the duodenum was difficult. Under the screen the barium mixture appeared to spurt at intervals through the narrow lumen. In many positions this narrowing of the lumen was aggravated, suggesting a sort of pinching. There was about 90 per cent residue in six hours and about 60 per cent in twenty-four hours. At forty-eight hours there was still considerable barium in the stomach.

The roentgen impression was nearly complete obstruction of the second section of the duodenum. The very smooth pattern of the narrowed duodenal lumen was noted. The possibilities of ulcer with or without cicatrization, polyp formation, neoplasm, abnormal bands, and adhesions were mentioned.

Surgery was recommended, and the patient was given an alkaline stomach powder to be taken until hospital admission. This so relieved his symptoms that he postponed the operation and was not seen again until some seven months later, in November 1951.

Repeat roentgen studies revealed precisely the same findings as before: obstruction, dilatation of

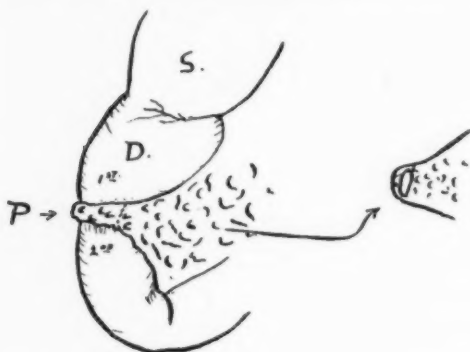


Fig. 3. Surgeon's expression of the anatomical relationships as seen at operation.

the stomach, narrowing of the duodenal lumen, and a gastric residue. The appearance of the duodenal canal appeared unchanged (Fig. 2). This observation was impressive and led to a definite diagnosis of annular pancreas.

Laboratory studies showed a secondary anemia (red blood cells 3,400,000, white cells 4,700, hemoglobin 10.9 mg.); non-protein nitrogen 25 mg. per cent; icteric index 5 units; serum amylase 6-7 units. Gastric analysis revealed a free hydrochloric acid of 30 at fasting level and a total acidity of 55 (fasting). After the test meal these figures gradually rose until at two hours they were 65 and 87.5, respectively. There was no blood but bile was present in all specimens.

Operation revealed a triangular tongue of pancreas (Fig. 3) passing across the duodenum at about the junction of the first and second sections. The pancreas was some 3 cm. in width, tapering to the right lateral side to about 0.7 cm. in diameter. This narrow part passed around the duodenum, the lumen of which was very narrow. The pancreatic tissue was normal to palpation. There was no sign of tumor. The gallbladder was normal in appearance.

So intimately adherent were the annular band and the duodenum that division or separation appeared to be surgically unjustifiable. A posterior gastroenterostomy isoperistaltic (no loop) was established. Following the operation the patient made an uneventful recovery and symptoms disappeared. Three months after operation, he had gained 36 pounds in weight and stated that he felt fine.

SUMMARY

There have been reported in the literature something over 60 cases of annular pancreas. The clinical symptoms of this condition are not diagnostic and it is usually recognized only at autopsy. A case is recorded here in which a preoperative diagnosis was made on the basis of a repeat roentgen examination which showed precisely the same degree of narrowing of the duodenal lumen as had been observed on the original films seven months earlier. At operation the narrowed lumen was found not to exceed 5 mm. in diameter.

Gastrojejunostomy appears to be the procedure of choice, especially when the connection between the duodenum and the pancreatic ring is intimate, as in this case.

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SUMARIO

Páncreas Anular

Se han comunicado en la literatura más de 60 casos de páncreas anular. Los síntomas clínicos de este estado no son diagnósticos y no se suele reconocerlo antes de la autopsia. Preséntase un caso en el que se hizo el diagnóstico preoperatoriamente a base de un examen roentgenológico repetido que reveló precisamente el mismo estrechamiento de la luz duodenal

por el circundante anillo pancreático que había sido observado en la radiografía primitiva siete meses antes. Al operar, se notó que el diámetro de la luz estrechada no excedía de 5 mm.

La gastroyeyunostomía parece ser el procedimiento de elección, sobre todo cuando la relación entre el duodeno y el anillo pancreático es íntima.



Roentgen Features of Pulmonary Tuberculoma¹

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A PULMONARY tuberculoma may be defined as a localized tuberculous focus of infection in the lung, firm, encapsulated, laminated, and often with central caseation. Its thick encapsulating fibrous wall distinguishes a tuberculoma from a primary tuberculous infection. The conclusions of Black and Ackerman (1) that it is a "post-primary lesion arising either from exogenous reinfection or focal extension from a primary focus, probably the former," seem logical. Roentgenologically a primary infection may resemble a tuberculoma; histologically it will be found to lack the fibrous encircling capsule present in the latter.

An apparent recent increase in the incidence of pulmonary tuberculomas can be attributed in large part to the advent of mass chest surveys. This fact and the present acknowledgment that surgery is the treatment of choice make accurate preoperative diagnosis important, in order to preserve normal lung tissue and to prevent unnecessarily radical procedures. This study presents certain roentgenologic features which are considered valuable in the diagnosis of pulmonary tuberculoma.

The investigation is based on 19 cases of proved tuberculoma treated at the Massachusetts General Hospital from 1938, when the diagnosis was first made, through April 1952. From 1939 through 1949, only 4 cases were found; the remaining 14 (74 per cent of the entire group) appeared during the last two and a quarter years, bearing out the observation that chest surveys have played a major role in establishing the diagnosis.

All 19 cases were proved by histologic examination of a surgically resected specimen. In 2, pneumonectomy was per-

formed, in 13 segmental resection or local excision of the tumor, and in 4 lobectomy.

CLINICAL DATA

Ten patients of the group were females; 9 males. The age range was from twenty-three to sixty-four years, the division into decades being relatively equal. This fact contradicts the claim of some (4) that tuberculomas occur most commonly in young persons.

In 14 cases (74 per cent) the patients were asymptomatic, the pulmonary lesions having been discovered on routine chest roentgenograms. In the 5 who had symptoms referable to the respiratory system, the chief complaints were dull chest pain, frequent "colds," chronic cough, fatigue, and, in 2 only, hemoptysis.

Bronchoscopy, carried out in 7 cases, was negative. Bacteriologic study of bronchial washings for tubercle bacilli gave positive results in only 3 cases, in 2 by direct smear and in 1 by guinea-pig inoculation.

Tuberculin skin tests were recorded in only 5 patients; the significance of the findings is therefore questionable. The test was positive in 2 in 1:1,000 dilution. One was negative in 1:10,000 dilution, one in 1:1,000 dilution, and a third, carried to a 1:100 dilution, remained negative.

ROENTGEN FEATURES

On the roentgenogram, a tuberculoma appears as a rounded, ovoid, or lobulated area of increased density, its margin being usually sharply defined. In some instances the lesion, whatever its shape, had a doughnut-like appearance, due to a central area of cavitation. In 4 such cases, pathologic and histologic confirmation of cen-

¹ From the Department of Radiology, Massachusetts General Hospital, Boston 14, Mass. Accepted for publication in May 1952.

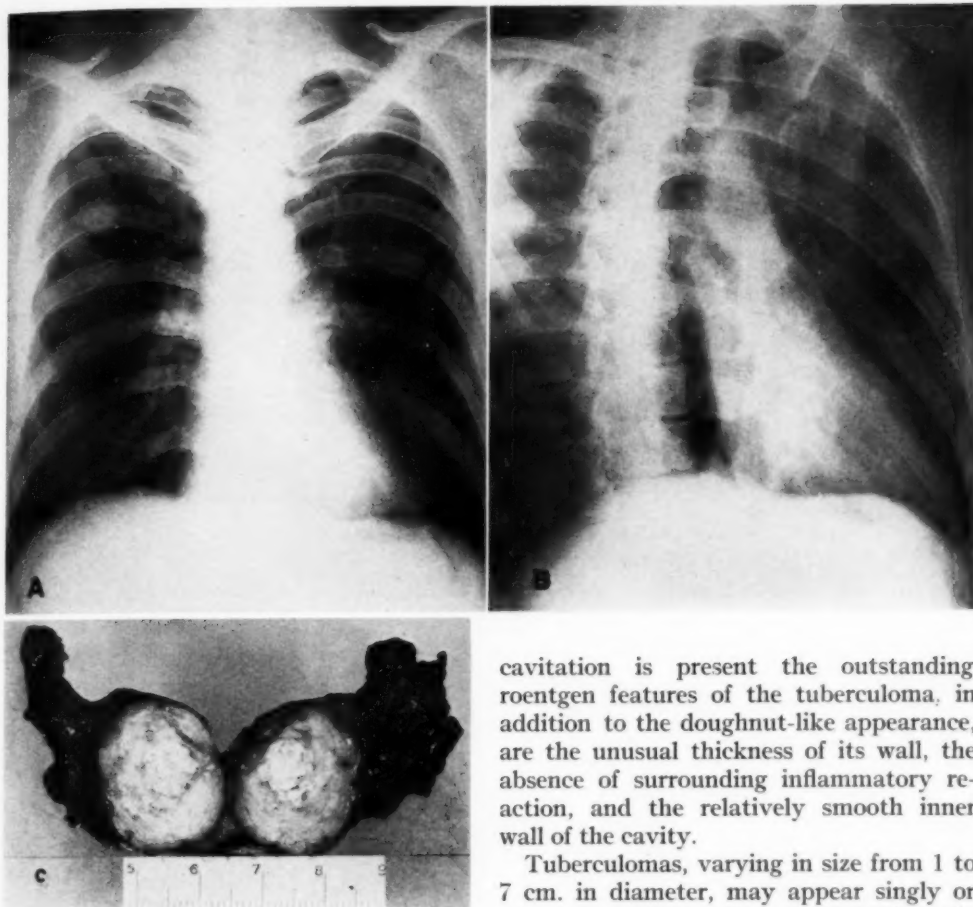


Fig. 1. "Typical" Tuberculoma.

A 42-year-old asymptomatic male was found on a chest survey examination to have a lesion in the right upper lobe of the lung.

A. *Postero-anterior roentgenogram* showing a discrete ovoid, homogeneous, sharply defined area of increased density, measuring 2.0×2.5 cm., in the posterior segment of the right upper lobe. There is some increased linear density overlying the right first interspace. Some calcification is seen at the right hilus.

B. *Right anterior oblique projection* showing that the lesion lies very close to the pleura posteriorly.

Operation: Excision of tumor. The pleural space was free of adhesions; there was puckering of the pleura overlying the tumor. There were numerous small calcific nodules on the underlying surface of the upper lobe, in the mediastinum, and posteriorly throughout the lung. *Histopathology:* Tuberculoma.

C. Surgical specimen.

cavitation is present the outstanding roentgen features of the tuberculoma, in addition to the doughnut-like appearance, are the unusual thickness of its wall, the absence of surrounding inflammatory reaction, and the relatively smooth inner wall of the cavity.

Tuberculomas, varying in size from 1 to 7 cm. in diameter, may appear singly or may be multiple. Five of the patients in the group under consideration had multiple tuberculomas. Roentgenologically these appeared as several small discrete lesions or as confluent conglomerations of many small lesions.

The location of the individual tuberculomas throughout the lungs was as follows: 10 were in the right upper lobe (6 in the apical segment, 1 in the anterior, and 3 in the posterior); 8 in the left upper lobe (7 in the apico-posterior segment and 1 in the anterior); 6 in the right lower lobe (5 in the superior segment and 1 in the subsuperior); 1 in the superior segment of the left lower lobe; 1 in the fissure between the right upper and right middle lobes. It is of note that the majority of these lesions were in the upper

tral cavitation was obtained. In 1 of the 4 a fluid level was observed in the central portion, raising the question of lung abscess as the diagnosis. When central

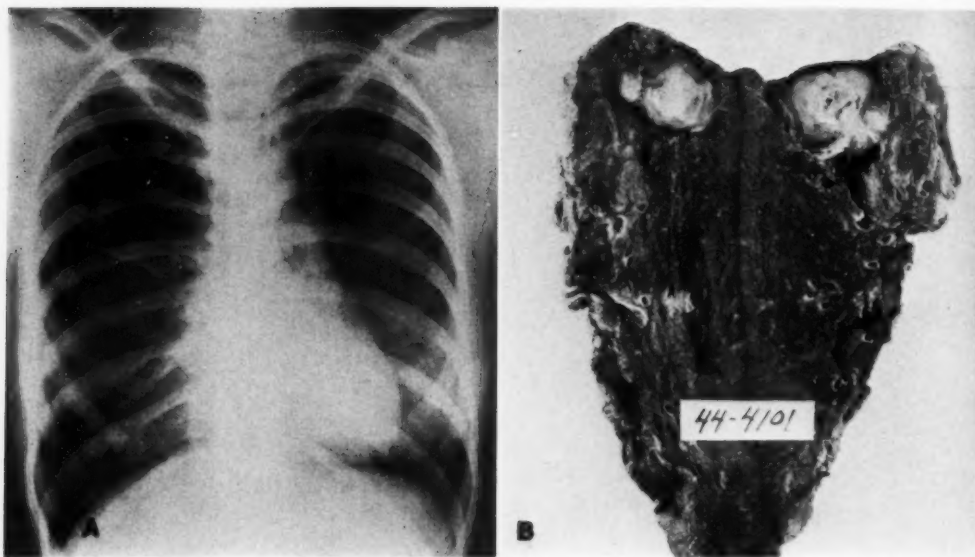


Fig. 2. Subpleurally Situated Tuberculoma, Demonstrated by Pneumothorax.

Fourteen months before admission, a 23-year-old female, because of fatigue and a non-productive cough, had a routine chest film taken, which revealed a "spot" in the right upper lung field. On admission to a sanatorium, a diagnosis of pulmonary tuberculosis was made on the basis of a positive sputum examination. Right pneumothorax was instituted and had been maintained for the eight months preceding hospital admission.

A. Roentgenogram showing partial pneumothorax on the right. Lying laterally in the right upper lobe, just above the interlobar fissure, are two small rounded areas of increased density measuring 1.5 and 2.0 cm. in diameter. Both lie close to the overlying pleura. There is some calcification in the right hilus.

Operation: Right upper lobectomy. Histopathology: Tuberculomas. A very firm 3-cm. ovoid mass with a 1-cm. area of central caseation and surrounded by a dense fibrous wall lay immediately beneath the pleura. Adjacent to one side of the mass was a satellite nodule, 1 cm. in diameter, having the same physical characteristics as the larger tumor.

(B) Surgical specimen.

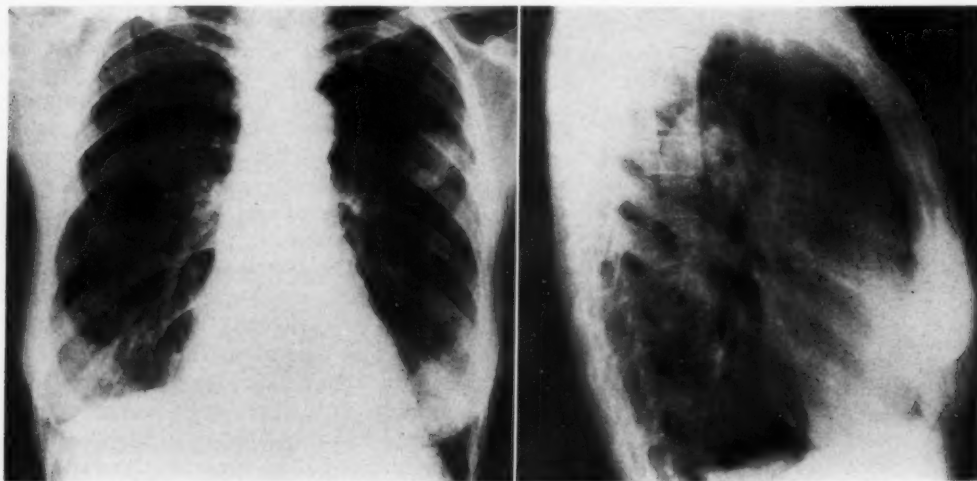


Fig. 3. Tuberculoma with Central Cavitation (Mass. Gen. Case Record 36412. New England J. Med. 243: 576-579, 1950).

A 64-year-old female had been asymptomatic when in 1947 a routine chest examination revealed a lesion in the left upper lung. She remained well, and periodic roentgen examinations showed no change in the appearance of the chest until she became ill with influenza in 1950. Subsequently she failed to regain her former state of well-being and a non-productive cough persisted. A roentgenogram at this time showed an increase in the size of the

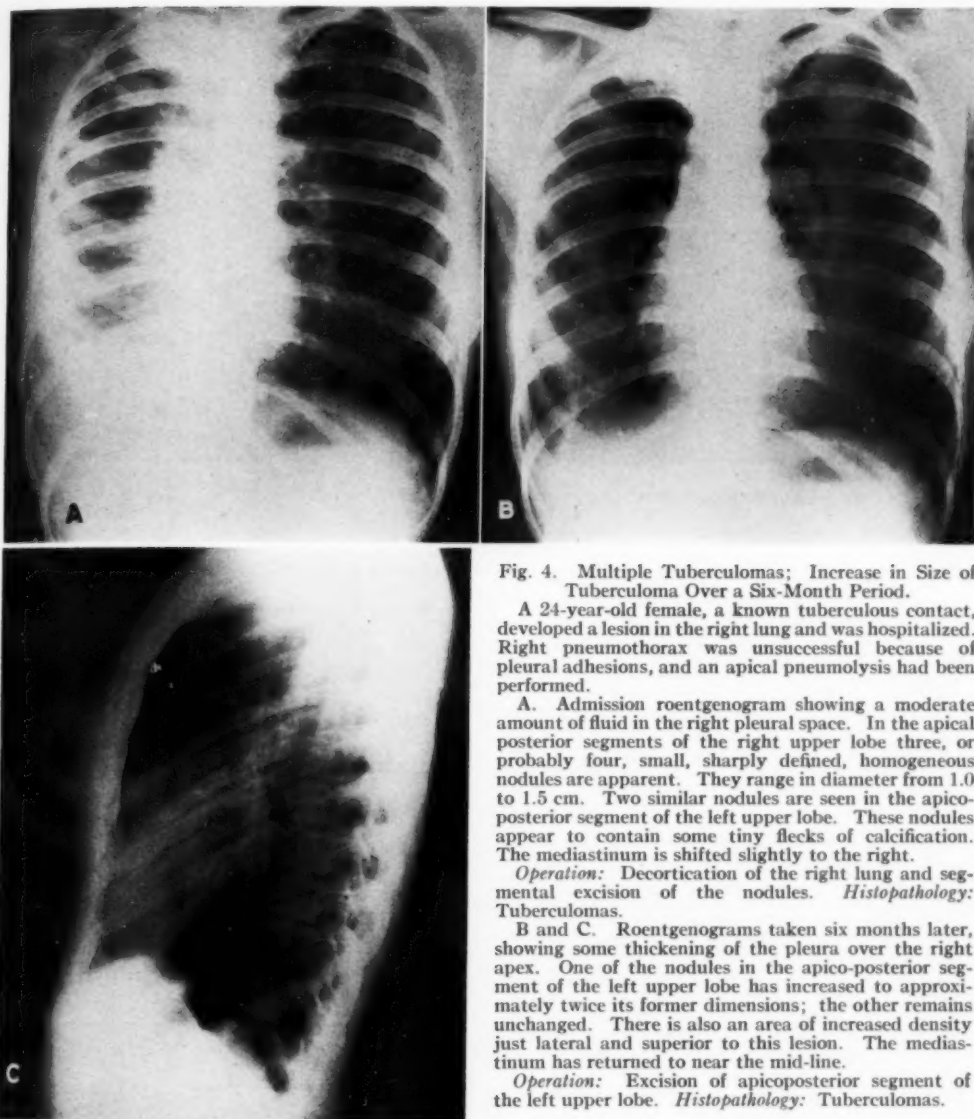


Fig. 4. Multiple Tuberculomas; Increase in Size of Tuberculoma Over a Six-Month Period.

A 24-year-old female, a known tuberculous contact, developed a lesion in the right lung and was hospitalized. Right pneumothorax was unsuccessful because of pleural adhesions, and an apical pneumolysis had been performed.

A. Admission roentgenogram showing a moderate amount of fluid in the right pleural space. In the apical posterior segments of the right upper lobe three, or probably four, small, sharply defined, homogeneous nodules are apparent. They range in diameter from 1.0 to 1.5 cm. Two similar nodules are seen in the apico-posterior segment of the left upper lobe. These nodules appear to contain some tiny flecks of calcification. The mediastinum is shifted slightly to the right.

Operation: Decortication of the right lung and segmental excision of the nodules. Histopathology: Tuberculomas.

B and C. Roentgenograms taken six months later, showing some thickening of the pleura over the right apex. One of the nodules in the apico-posterior segment of the left upper lobe has increased to approximately twice its former dimensions; the other remains unchanged. There is also an area of increased density just lateral and superior to this lesion. The mediastinum has returned to near the mid-line.

Operation: Excision of apicoposterior segment of the left upper lobe. Histopathology: Tuberculomas.

portions of the lobe in which they were located.

Of particular interest is the fact that

17 (90 per cent of the entire group) of the tuberculomas were peripherally situated, lying very close to the pleura. In the

pulmonary lesion, with cavitation. A diagnosis of tuberculosis was established by histologic examination of an enlarged axillary lymph node.

Roentgenograms show a 3.0-cm. mass with a 1.3-cm. area of radiolucency in its center lying in the axillary portion of the anterior segment of the left upper lobe close to the pleura. A few flecks of calcification are demonstrated within the lesion, as well as in both hilar regions. In the lingular segment of the left upper lobe is an area of increased density. The left costophrenic angle is blunted posteriorly.

Operation: Left upper lobectomy. Histopathology: Tuberculoma. On section, no communication with the bronchi was found. In the center of the tuberculoma was an empty cavity 1.3 cm. in greatest diameter, surrounded by a thick fibrous wall. There was evidence of atelectasis and congestion in the lingula of the left upper lobe.

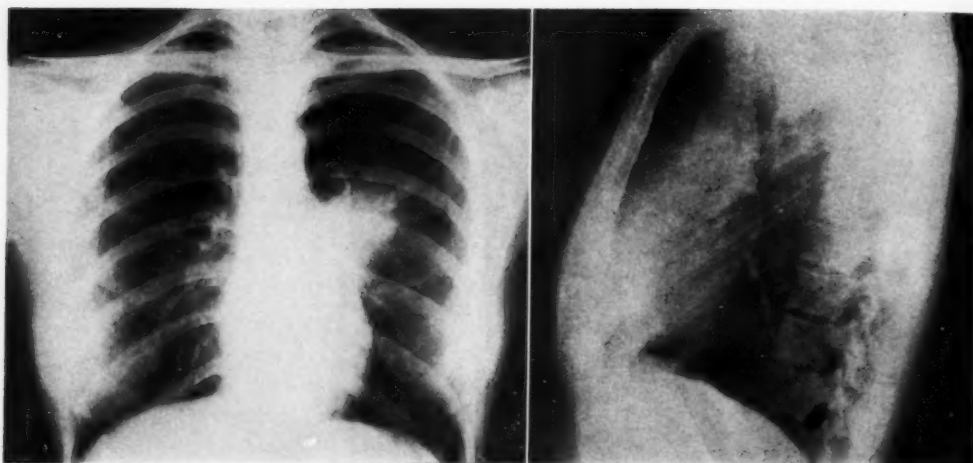


Fig. 5. Confluent Tuberculomas Simulating Carcinoma (Mass. Gen. Case Record 29322. New England J. Med. 229: 296-300, 1943).

A 27-year-old female was admitted complaining of substernal pain of eighteen months duration, anorexia, fatigue, and 11 pounds weight loss. She had had a cough for two weeks but no hemoptysis. Sputum examination was negative for acid-fast bacilli. A tuberculin skin test was negative in 1:10,000 dilution; positive in forty-eight hours, 1:1,000.

Roentgenograms show an area of increased density, nodular in outline, in the anterior segment of the left upper lobe close to the hilus. There is some calcification within the mass. The involved lobe is slightly reduced in size.

A tentative diagnosis of lymphoma was made, and the patient received a therapeutic trial of radiation therapy, 900 r, front and back, being delivered to the left hilus. No regression of the lesion followed. Subsequent bronchoscopy was negative.

Operation: Left pneumonectomy (with a preoperative and postoperative diagnosis of carcinoma of lung). *Histopathology:* Multiple confluent tuberculomas. The main mass of the involved lung showed numerous discrete and confluent areas of caseation.

The patient is alive and well nine years after operation.

other 2 cases one lesion, composed of confluent tuberculomas, was so large that it extended from the hilus to the periphery of the lung; the other lay within a fissure.

Collapse of the lung, lobar or segmental, was practically absent in the present series; 2 cases only showed slight collapse of the involved lobe. In 1 of these, the tuberculoma was a confluent mass, while the other was made up of multiple discrete tumors. The subpleural situation of the majority of tuberculomas, without associated involvement of the major bronchi would readily explain this absence of collapse of the lung.

A much discussed point of diagnostic importance is whether in its natural course a tuberculoma changes in size and/or appearance. In 11 of the present group, serial roentgenograms were available for determination of this point. In 10 cases the tuberculoma increased in size over varying periods of time; 2 doubled their

size within a year; 1 in six months; 1 during a two-year follow-up increased in size by one-third. The contour and general appearance of the tumor remained the same; growth was more or less concentric. In the case which showed no evidence of change in size, there was an interval of only one month between roentgen examinations. In 1 case of multiple tuberculomas, re-examination at the end of six months showed that one of two lesions situated in the same segment of a lobe had doubled its size while the other remained unchanged.

Calcification within the tuberculoma was observed in 9 cases, this calcification had a "flecky" appearance, like very fine stippling, in the center of the tumor. No laminated calcification was seen (7).

A search for associated pulmonary changes was made. In 13 instances there was evidence of hilar lymph node calcification. In 2 cases there was a suggestion of

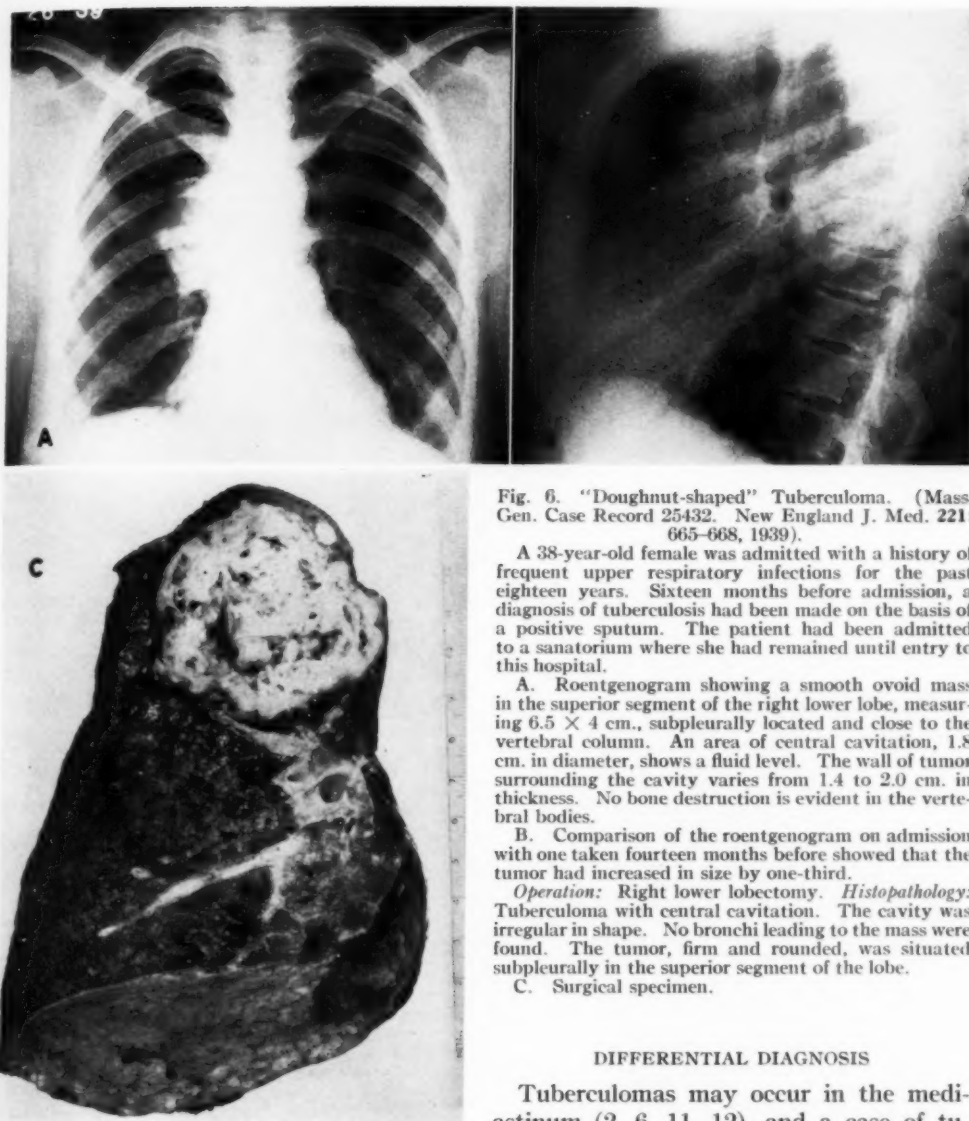


Fig. 6. "Doughnut-shaped" Tuberculoma. (Mass. Gen. Case Record 25432. New England J. Med. 221: 665-668, 1939).

A 38-year-old female was admitted with a history of frequent upper respiratory infections for the past eighteen years. Sixteen months before admission, a diagnosis of tuberculosis had been made on the basis of a positive sputum. The patient had been admitted to a sanatorium where she had remained until entry to this hospital.

A. Roentgenogram showing a smooth ovoid mass in the superior segment of the right lower lobe, measuring 6.5×4 cm., subpleurally located and close to the vertebral column. An area of central cavitation, 1.8 cm. in diameter, shows a fluid level. The wall of tumor surrounding the cavity varies from 1.4 to 2.0 cm. in thickness. No bone destruction is evident in the vertebral bodies.

B. Comparison of the roentgenogram on admission with one taken fourteen months before showed that the tumor had increased in size by one-third.

Operation: Right lower lobectomy. Histopathology: Tuberculoma with central cavitation. The cavity was irregular in shape. No bronchi leading to the mass were found. The tumor, firm and rounded, was situated subpleurally in the superior segment of the lobe.

C. Surgical specimen.

DIFFERENTIAL DIAGNOSIS

Tuberculomas may occur in the mediastinum (2, 6, 11, 12), and a case of tuberculoma of the diaphragm has been reported (13). These lesions, however, are unlikely to be confused with pulmonary lesions. Lung abscess must be considered in the differential diagnosis, particularly if the presumed tuberculoma shows cavitation. In true lung abscess, an inflammatory reaction is usually evident, surrounding the abscess cavity, the outer border of the area of increased density being ill-defined. Tuberculoma, on the

enlargement of the intrathoracic lymph nodes lying in the drainage pathway of the involved lobe (10). Three cases showed minimal parenchymal infiltration of either old or recent tuberculous infection. Any pleural changes noted were slight and consisted of thickening. In 1 case a bronchopleural fistula originated in the tuberculoma and was the source of a tuberculous empyema with partial pneumothorax.

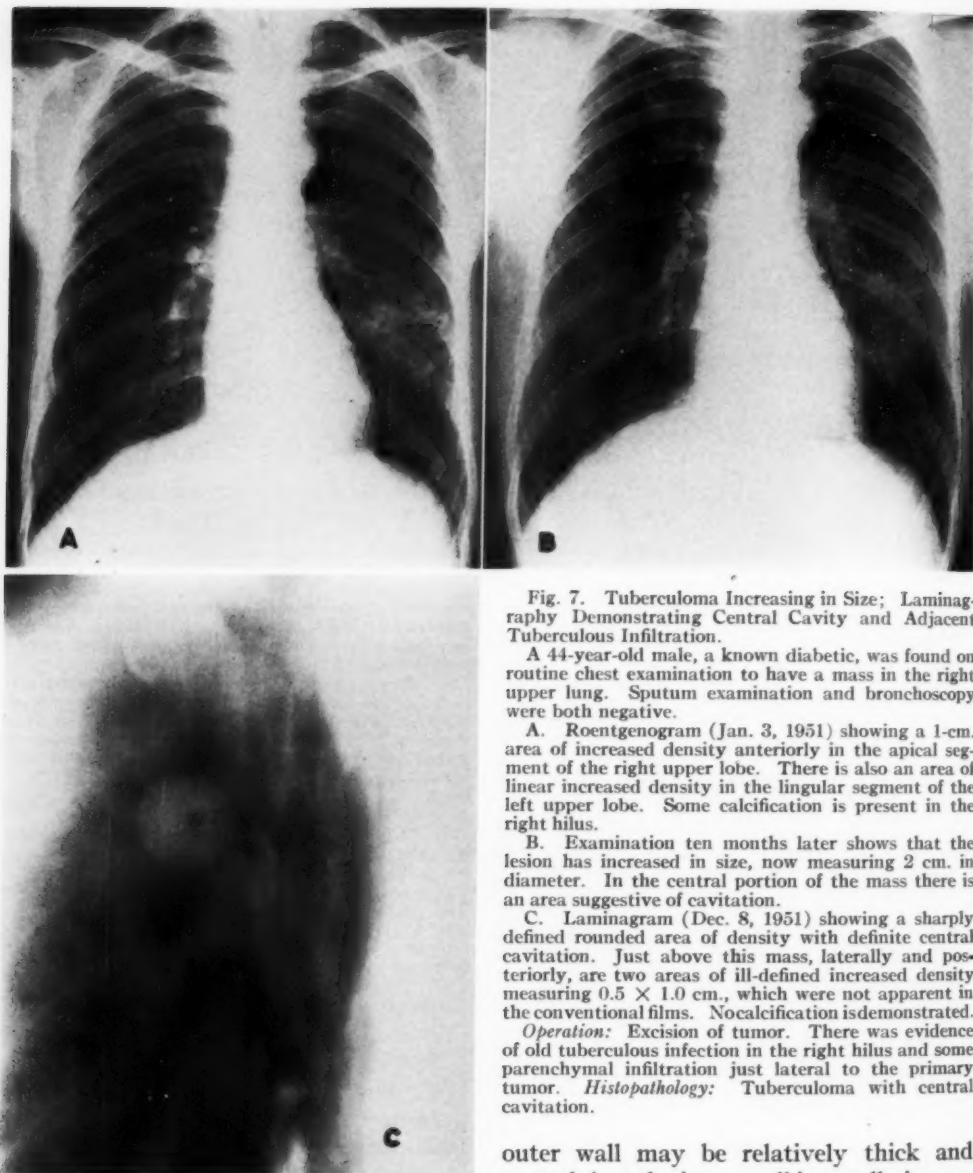


Fig. 7. Tuberculoma Increasing in Size; Laminagraphy Demonstrating Central Cavity and Adjacent Tuberculous Infiltration.

A 44-year-old male, a known diabetic, was found on routine chest examination to have a mass in the right upper lung. Sputum examination and bronchoscopy were both negative.

A. Roentgenogram (Jan. 3, 1951) showing a 1-cm. area of increased density anteriorly in the apical segment of the right upper lobe. There is also an area of linear increased density in the lingular segment of the left upper lobe. Some calcification is present in the right hilus.

B. Examination ten months later shows that the lesion has increased in size, now measuring 2 cm. in diameter. In the central portion of the mass there is an area suggestive of cavitation.

C. Laminagram (Dec. 8, 1951) showing a sharply defined rounded area of density with definite central cavitation. Just above this mass, laterally and posteriorly, are two areas of ill-defined increased density measuring 0.5×1.0 cm., which were not apparent in the conventional films. Nocalcification is demonstrated.

Operation: Excision of tumor. There was evidence of old tuberculous infection in the right hilus and some parenchymal infiltration just lateral to the primary tumor. Histopathology: Tuberculoma with central cavitation.

other hand, exhibits an unusually thick, sharply outlined outer wall and the lining of the cavity is comparatively smooth. Other diseases to be taken into consideration are primary peripheral carcinoma, metastatic carcinoma, benign tumors of the lung, coccidioidosis, and localized non-specific infectious processes. In the case of a centrally necrotic malignant tumor, the

outer wall may be relatively thick and smooth but the inner wall is usually irregular, showing one or more projections of tumor tissue extending into the cavity (8). In some cases it may be impossible to make a definite diagnosis of tuberculoma from the roentgenogram alone.

TECHNIC OF ROENTGEN EXAMINATION

As in the diagnosis of any pulmonary lesion, complete roentgenologic examina-

tion of the chest should be carried out in the search for a tuberculoma. Fluoroscopy with spot films, always an essential part of the study, is particularly valuable in identifying this type of tumor because of its predominantly subpleural location. A barium swallow and an overexposed postero-anterior projection may be useful in evaluation of disease in the mediastinum. Lateral and oblique roentgenograms should always be taken, in addition to the usual postero-anterior view.

Laminagraphy may be useful in establishing the presence of calcification within a tuberculoma, but its chief asset lies in the identification of additional tuberculous foci adjacent to the primary tuberculoma and in the demonstration of central cavitation.

DISCUSSION

The general trend in treatment of tuberculoma is toward surgical intervention (1, 3, 5, 9), first, in order to remove the potential source of tuberculous spread; and, second, to establish the exact nature of the pulmonary lesion. Clinical and laboratory methods of diagnosis are limited. Bronchoscopy is seldom helpful in diagnosing the primary tuberculoma. It has value, however, in eliminating disease of the major bronchi, both by visual inspection and by affording opportunity for cytologic and bacteriologic studies of bronchial washings. Bronchography adds little of diagnostic value. Careful roentgenographic examination offers the most promising means of making the diagnosis.

SUMMARY

The roentgen features of tuberculoma, based on a study of 19 cases of proved lesions, may be summarized as follows: (a) the presence in the lung of a round, ovoid, or lobulated area of increased density, which may be single or multiple; (b) evidence, on serial roentgenograms, of progression in size of the lesion over a period of

time; (c) a tendency toward central cavitation; (d) in some instances the presence of "flecky" calcification within the tumor; (e) the location of the lesion beneath and close to the pleural surface of the lung, most commonly in the apical segment of an upper lobe or superior segment of a lower lobe.

In the presence of single or multiple tuberculomas, the remaining lung fields may show evidence of a minimal degree of tuberculous infection—old or recent, absence of enlargement of intrathoracic lymph nodes, and absence of significant collapse of lobes or segments of lobes of the lung.

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Para el sumario en español, véase la página siguiente.

SUMARIO

Características Roentgenológicas de los Tuberculomas Pulmonares

Como la cirugía está aceptada como el tratamiento de elección para los tuberculomas pulmonares, es importante el diagnóstico preoperatorio acertado de los mismos, a fin de conservar el tejido pulmonar normal y de evitar innecesarios procedimientos radicales. Un cuidadoso examen con los rayos X ofrece el medio de más promesa para el diagnóstico. A base del estudio de 19 casos comprobados, las características roentgenológicas son las siguientes: presencia en el pulmón de una zona redonda, ovoidea o lobulada de mayor densidad, que puede ser única o múltiple; signos en las radiografías seriadas de aumento de tamaño de la lesión

durante cierto período de tiempo; tendencia a la cavitación central; en algunos casos, presencia en el tumor de finos flecos de calcificación produciendo aspecto punteado; localización debajo y cerca de la cara pleural del pulmón, más comúnmente en el segmento apical del lóbulo superior o segmento superior de un lóbulo inferior.

Cuando existen tuberculomas aislados o múltiples, los otros campos pulmonares pueden revelar signos de infección tuberculosa de forma mínima—ya vieja o reciente—ausencia de hipertrofia de los ganglios linfáticos intratorácicos y ausencia de notable colapso de lóbulos o segmentos lobulares de los pulmones.



Roentgen Amniography: A Valuable and Safe Aid to Obstetrical Diagnosis¹

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ESSENTIALLY, amniography consists of opacifying the amniotic fluid in the pregnant uterus with a suitable contrast medium in order to delineate the uterine cavity and to study certain aspects of maternal and fetal physiology. The method has undergone many vicissitudes. Meneses and Holly and their collaborators (1, 2), who originated the procedure in 1930, used it near term with the chief purpose of determining the location of the placenta. They accomplished the opacification by puncturing the abdomen and uterus with a long needle through which sodium or strontium iodide was injected. The reproductions in their early reports show clearly the opacified amniotic fluid and reveal the floating fetus with its soft tissues as a "negative shadow." The amniotic sac was seen to conform to the pyriform configuration of the gravid uterus except in one area, where the symmetry was interrupted by a filling defect identified as the placenta. Meneses and his associates were able to locate the placental site correctly each time they used the method. They also noted that the fetus swallowed the opaque medium, which could be seen in the fetal bowel.

While the originators stated that the method was safe in their hands, several other workers, notably Kerr and Mackay (3) and Cornell and Case (4), felt that it was dangerous and of rather limited use, suggesting that it should be abandoned. Sodium and strontium iodide were considered too irritating as contrast media, resulting in several fetal deaths and too frequently in undesirable induction of labor. Cornell and Case also warned against the danger of puncturing vital fetal structures with the needle or entering the large

vessels of the placenta or the umbilical cord, producing a lethal hemorrhage. These authors abandoned the inorganic iodides as contrast media, using Neoskiodan or Uroselectan B instead. The latter was found to induce labor so regularly that Burke (7) began to use the medium for that special purpose. He found amniotic puncture in itself to be without harmful effects to the mother or fetus in 75 consecutive cases. Cetroni and Azariti (5), as well as Albano and Gallina (6), stated that the method was safe with either the organic or inorganic iodides available in 1934.

Amniography in advanced pregnancies was apparently abandoned following these controversies, since it received no further mention in the literature until 1948, when numerous articles appeared in French publications, chiefly under the authorship of Granjon and numerous collaborators (10-14). Ginglinger (9) and Reid (15) also used the method. These authors recommend the media ordinarily employed in intravenous pyelography. Granjon (11) tried several products and found the American and Swedish preparations to be the most satisfactory. He insists that the method is free of any danger to the maternal or fetal organism.

Coincidentally with the work outlined above, Erbslöh (28), Davis and Potter (30), Ehrhardt (19, 26), Windle *et al.* (21, 23, 25), Reifferscheid and Schmie-mann (22), Szendi (24), and Speert (29) were conducting various studies on fetal physiology. The experimental subjects were either animals in varying stages of pregnancy or women in the early weeks of pregnancy in whom a therapeutic abortion was to be performed. Several types of

¹ From the Department of Roentgenology, Holy Cross Hospital, Detroit, Mich. Accepted for publication in June 1952.

contrast media, chiefly colloidal thorium, were injected into the amniotic sac of the pregnant uterus. All authors state that these injections produce no deleterious effects in the maternal organism.

WHAT CAN BE ACCOMPLISHED BY
ROENTGEN AMNIOGRAPHY AND
WHY SHOULD IT BE PERFORMED?

1. As stated above, amniography primarily delineates the uterine contents. In addition, it provides valuable information which can be obtained neither by clinical examination nor by more conventional roentgen studies. While a soft-tissue roentgenogram in a lateral projection will delineate the placenta in well over 90 per cent of cases, there are certain instances where it fails, as in early pregnancies, most multiple pregnancies, transverse presentations of the fetus, and in low implantations. Roentgenograms of excellent quality also fail at times to reveal a definite placental shadow when there are no obvious complications. Cystograms, with opaque media or air are sometimes misleading, as a bulging bag of waters between the fetal head and the urinary bladder may be misinterpreted as the placenta; and the cystogram, of course, is of no value when the presenting part of the fetus is not engaged. Amniography, on the other hand, will unerringly locate the placenta as a filling defect in the symmetrical pyriform shadow of the amniotic sac under all conditions.

2. When uterine tumors are suspected coincidental with pregnancy, amniography will locate them accurately. It will determine the size of the portion of the tumor pressing against the uterine lumen and make it possible to distinguish the placenta from the tumor. The present series of cases includes two such instances.

3. The amniogram will reveal any deformity or other cause in the uterus which might be responsible for abnormal presentation of the fetus. Granjon *et al.* (13) mentioned a case of shoulder presentation, in which the amniogram revealed a septum in the uterine cavity which would

have rendered any attempt at delivery by version and extraction a useless and dangerous maneuver.

4. Whenever any abnormality of the fetus is suspected, amniography is invaluable. Since the fetus appears as a negative shadow in the amniotic opacity, any major soft-tissue abnormalities such as large meningoceles or myeloceles can be seen. This finding could again modify the obstetrical management, especially in a pelvis with borderline diameters. Granjon (13, 14) published a beautiful example: a fetus with almost complete absence of bony structures but with a relatively normal external configuration of the soft tissues as seen in the amniogram. In view of the high incidence of fetal monstrosities associated with hydramnios, it is perhaps wise to consider hydramnios as a major indication for amniography.

5. Granjon (12), Cetrone and Azzariti (5), Albano and Gallina (6), and Kerr and Mackay (3) claim to have been able in a few instances to detect the sex of the fetus before birth and they also state that the umbilical cord at times can be seen. This, however, has not been true in the present series of cases.

6. Where multiple pregnancies exist, amniography will determine whether they are of the uniamniotic or biamniotic variety and also locate the single or double placenta (10-14).

7. When films are taken at a period of approximately three hours following the initial opacification of the amniotic fluid, certain interesting phenomena occur. First, the fetus swallows the opacified fluid, which can be easily identified in the fetal bowel *providing the fetus is alive*. Every investigator using amniography has found swallowing to occur. Szendi (24) demonstrated it radiologically in a six-week-old fetus, following injection of Thorotrast and abortion seventy-two hours later. This is apparently the youngest human fetus in which gastrointestinal activity has been observed. Since swallowing and propulsion of material in the bowel are a vital activity which cannot occur after

death of the fetus, amniography shows in every instance whether the fetus is alive or dead and is extremely valuable when the diagnosis of fetal death cannot be made otherwise. Except for Ehrhardt (19), previous workers have not mentioned this method of diagnosing fetal death, but it would seem worthy of emphasis.

8. Another interesting phenomenon observed in delayed films is that of absorption of the contrast material. In this series of cases, Diodrast has been the medium of choice. In three hours following introduction of this substance into the amniotic sac, the opacity of the amniotic fluid has noticeably decreased. In all probability, some of the ingested Diodrast is absorbed from the fetal bowel into the blood stream of the fetus and is then carried by the umbilical arteries, through the placental barrier, to enter the maternal circulation. That another route of absorption is present is indicated by a case of fetal death to be presented, in which the opacity of the amniotic fluid was also diminished and the Diodrast appeared in the maternal circulation. It is believed that the amniotic membrane actively absorbs the medium, although no proof can be given for this statement. In any event, three hours following its introduction the Diodrast is excreted by the maternal kidneys so that an excretory pyelogram is obtained. If the patient is instructed not to urinate during this interval, we have an opaque cystogram which reveals the intimate relationship between the urinary bladder and the still opacified amniotic fluid in the lower uterine segment. Granjon was the first to make use of this phenomenon. The relative frequency with which uterine and urinary tract abnormalities are associated makes the study of the pyelogram doubly interesting.

If more speculation is permissible, one may suggest the possibility of detecting abnormalities of the gastrointestinal tract, such as esophageal or duodenal atresia even before birth, by studying the disposition of the ingested Diodrast in the fetus. Furthermore, in view of the in-

nocuity of amniotic puncture, as reported in the literature, and the ease with which it is performed, it appears that amniotic fluid might prove to be a fruitful and untapped source of body fluid for chemical analysis, in various complement fixation tests, and other serologic and biologic reactions. The constituents of this fluid could very conceivably vary after death of fetus, allowing such a diagnosis to be made at an earlier date than is now feasible.

WHAT CAN AMNIOGRAPHY TEACH ABOUT FETAL PHYSIOLOGY?

The study of Diodrast in the fetal bowel has also proved revealing. The small bowel of the unborn fetus, as shown in amniographic studies, reveals an entirely different appearance from that of the newborn. The writer has studied the bowel pattern of the fetus three hours following injection of 70 per cent Diodrast into the amniotic sac. In this interval, a thorough opacification of the small bowel and a portion of the colon occurs regularly. In a few instances, the Diodrast was swallowed almost immediately after its introduction into the amniotic cavity. In every case, a smooth, continuous and solid column of Diodrast was seen in the small bowel, resembling the distribution observed in the adult much more than the irregularly fragmented pattern usually seen in the newborn. No satisfactory explanation for this difference can be offered, though it may be that the behavior of Diodrast as it passes through the small bowel differs from that of barium.

In spite of a careful study, no demonstration of activity of the fetal urinary and respiratory tracts was secured in the series of cases to be reported here, nor did a search of the literature reveal any method by which fetal urinary tract function can be shown roentgenographically. The question of physiologic respiration by the fetus *in utero* has, on the other hand, occasioned considerable controversy, with experiments by various authors, often ending in diametrically opposite conclusions. Certain

authors believe that the fetus breathes regularly and rhythmically in the late stages of pregnancy; others flatly deny this stating that any respiratory activity before birth is always pathologic, while still others have arrived at inconclusive results. The question was studied carefully by Ahlfeld (16, 17), Snyder and Rosenfeld (18, 20), Ehrhardt (19, 26), Windle, Becker, *et al.* (21, 23, 25), Reifferscheid and Schmiemann (22), Szendi (24), Pischinger (27), Erbslöh (28), and Davis and Potter (30). In an attempt to analyze these numerous contributions, it was difficult to escape the conclusion that fetal respiration *in utero* is an abnormal phenomenon that was seen to occur mostly when experiments were performed under rather unphysiologic conditions. The best summary of the problem is given by Windle in his excellent book on *Physiology of the Fetus* (23).

Another important consideration which merits discussion is the hydrodynamics of amniotic fluid. Many of the earlier workers in amniography stated that the procedure often resulted in induction of labor, and this they blamed upon the contrast medium. In performing uterine puncture, one should keep in mind the fact that uterine distention from any cause is one of the important factors in the initiation of uterine contractions. Thus, the frequent incidence of premature labor in acute hydramnios is explained. Granjon (8) has emphasized this fact and states that he has frequently been able to carry patients with hydramnios to term successfully by removing, at approximately weekly intervals, just enough amniotic fluid (200 to 300 c.c.) to relieve the tautness of uterine distention. The removal was accomplished by puncture of the abdominal wall and uterus with a lumbar puncture needle as in amniography. As a counterproof, Granjon in a personal communication to the author stated that in cases of fetal death he has induced labor by injection of sterile normal saline solution in the amniotic cavity (200 to 500 c.c.).

From a practical point of view, there-

fore, it is well in performing amniography to remove a quantity of fluid equal to or greater than the amount to be injected, unless it is immaterial whether or not labor begins promptly. The removal of fluid is especially important in the presence of hydramnios. By using these precautions the onset of labor was not produced in any of the present series of cases.

TECHNICAL CONSIDERATIONS

In every instance where amniography is considered, plain roentgenograms without a contrast medium should be obtained. A lateral soft-tissue projection of high technical quality is necessary in order to localize the placental site if possible. This obviates the risk of puncturing the placenta. In cases of placenta praevia, this is usually not to be feared because of the low implantation site. The importance of previous placental visualization comes into play, however, when the amniograms are performed because of other indications, such as suspected fetal death, suspected uterine tumors, fetal monstrosities, etc. Granjon (10, 11, 13) has punctured the placenta on occasion without any untoward results and this also occurred in one instance in the present series, again without complications. Nevertheless, it is certainly to be avoided if possible. The plain roentgenograms also give important information concerning fetal position.

In puncturing the amniotic sac, it appears wise to introduce the needle near the mid-line of the mother's abdomen in order to avoid puncturing the bowel, which is pushed into the flanks and posteriorly by the pregnant uterus. One must also introduce the needle into a pool of amniotic fluid in order to withdraw the fluid. Such a pool is usually encountered just caudal to the chin and in front of the chest wall of the fetus. The fetal back is ordinarily in such close contact to the uterine wall that no amniotic fluid can be withdrawn at this point. In one of the cases to be reported here in which the puncture was first made at this site, the fetus was delivered by cesarean section and was

found to have several needle puncture marks over the skin of one scapula. Needless to say, the correct diagnosis of fetal position and presentation prevents a possible puncture of a vital or important fetal structure.

Prior to amniography, the mother's bladder should be emptied by spontaneous urination or by catheterization. If the plain roentgenograms were obtained, several days prior to amniography, a single film in anteroposterior position should be obtained and studied immediately after developing, to insure against any possible change in fetal position.

The site of uterine puncture is chosen, as noted above, to avoid puncture of the maternal bowel and of vital fetal structures. It usually is in the para-umbilical area within a radius of two inches from the navel. The skin is infiltrated with novocaine and a subsequent infiltration is carried out down to the peritoneum. A 20-gauge lumbar puncture needle with the stylet inserted is introduced through the layers of the abdominal wall and peritoneum as well as through the uterine wall. A distinct "give-away" sensation is experienced on going through the peritoneum and again when the uterus has been punctured. When one suspects that the uterine cavity has been entered the hand should be removed from the needle, which is seen to move to and fro because of the fetal movements abutting against the point. Ordinarily, the needle must be introduced almost to the hilt. The only discomfort experienced by the patient is when the needle traverses the peritoneum, but with previous infiltration this is slight.

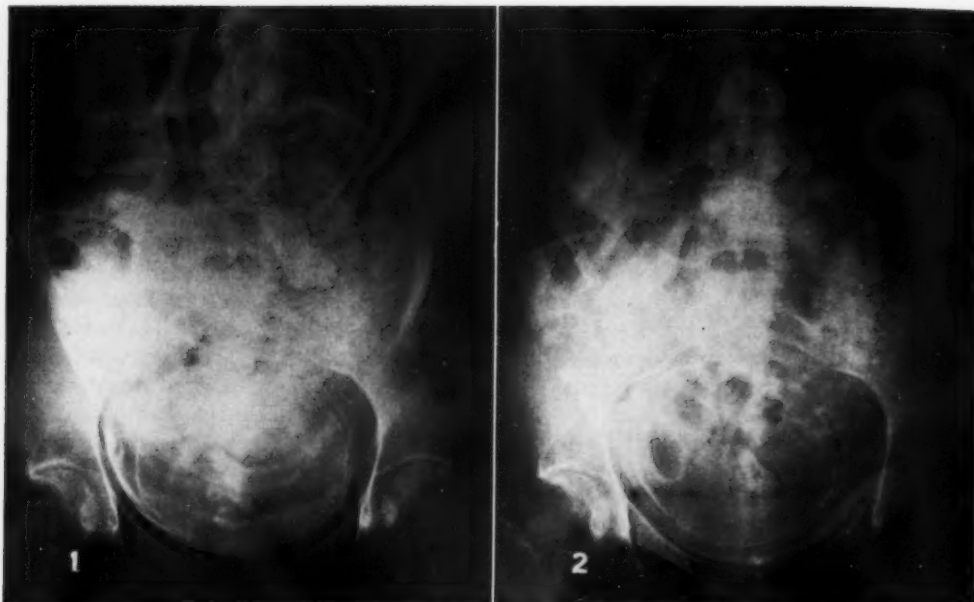
The stylet is next removed from the needle and a syringe is connected in order to aspirate the amniotic fluid. If no fluid is obtained, the position of the needle is changed without pulling it out of the uterus and usually after a few attempts fluid can be easily aspirated. If blood is aspirated, the position of the needle must also be changed until clear amniotic fluid appears in the syringe. Occasionally, it has been necessary to puncture the abdomen in a

new location, in which event every maneuver mentioned above must be repeated.

The contrast material of preference has been 70 per cent Diodrast. The amount injected varies with the case. In the average patient at or near term, 40 c.c. of this solution has been used. When the uterus appears smaller than average, the amount can be decreased, and in cases of hydramnios, 50 c.c. and even more should be used. The amount of Diodrast depends upon the quantity of amniotic fluid and should be varied only with the object of producing sufficient opacification of the fluid to permit satisfactory visualization of the uterine contents. In my first attempt with a six-and-a-half-month pregnancy, I used 40 c.c. of 35 per cent Diodrast with satisfactory results, although the degree of opacification was rather slight. When the amount of fluid to be injected has been determined, an equal or greater quantity of amniotic fluid is aspirated into a 50-c.c. syringe and the Diodrast, previously warmed to body temperature, is injected into the uterine cavity. The lumbar needle is then removed.

The patient is then rolled from side to side and tilted cephalad and caudad on the examining table in order to insure adequate diffusion of the medium. It is also preferable to have her walk about for a period of several minutes up to one-half hour. She is then returned to the examining table and films of the abdomen are obtained in anteroposterior, lateral, and even oblique projections, for immediate study. These immediate films will usually give information as to placental implantation or lower segment uterine tumors. In some of the cases near term, visualization of the fetal esophagus and stomach has also been obtained. If the Diodrast has not been adequately diffused, it will be found pocketed in various levels, generally in the lower half of the uterus.

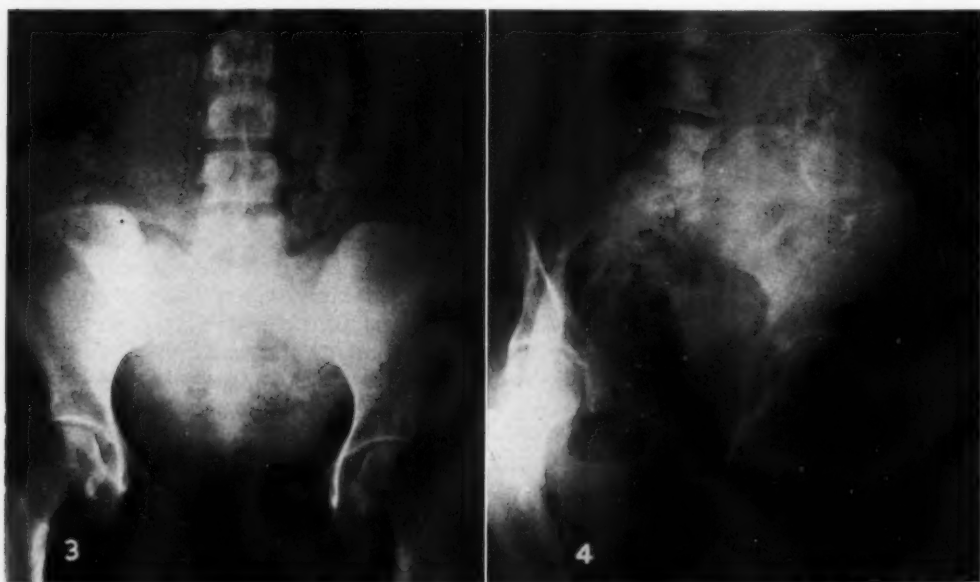
The patient is then returned to her room and is carefully instructed not to urinate. Three hours later, she is returned to the x-ray department for additional films, which invariably show a more uniform



Figs. 1 and 2. Case I.

Fig. 1. Normal full-term amniogram immediately following injection. The placenta is located high in the left uterine fundus. The injection was made into the mid portion of the uterus on the right side where most of the Diodrast remains. Note the Diodrast in the fetal stomach.

Fig. 2. Normal full-term amniogram three hours after injection. The bladder is filled with opaque urine from the excretory pyelogram. The amniotic fluid is somewhat less opaque and the diffusion is more uniform. There is now a large amount of Diodrast in the fetal bowel.



Figs. 3 and 4. Case II.

Fig. 3. Amniogram at six and a half months gestation, immediately after injection of 40 c.c. of 35 per cent Diodrast. The amniotic sac and the fetus are well outlined. There is a filling defect in the lower right uterine segment representing a marginal placenta praevia.

Fig. 4. The placenta is seen in the lower right posterior uterus extending down to the internal os.

diffusion of the Diodrast throughout the amniotic fluid. The outline of the fetal soft-tissue structures is well seen and the Diodrast is demonstrable throughout the small and large bowel of the fetus except in cases of fetal death. The maternal urinary bladder is opacified and its relation to the lower uterine segment can be studied. The distended lumina of the kidneys and ureters can also be seen.

CASE I (Figs. 1 and 2): Although this case was not the first studied from a chronological point of view, it is placed at the head of the list because it represents a normal full-term pregnancy. The immediate excuse given to the patient for performing uterine puncture was a somewhat excessive bloody show just preceding labor. Both the preliminary films and the amniographic studies show the placenta implanted high in the posterior uterine fundus. There was prompt swallowing of the Diodrast (40 c.c. of 70 per cent solution) after injection, delineating the fetal esophagus and stomach. The amniocystogram three hours following the injection is also well demonstrated.

CASE II (Figs. 3 and 4): This case represents the author's first attempt at amniography. The patient was a multipara, six and a half months pregnant, suffering from repeated hemorrhages. Speculum examination showed suspicious evidence of placenta praevia. Preliminary roentgenograms revealed the fetus high in the uterus in transverse presentation; the placenta could not be visualized. Without knowing the exact amount of contrast medium to use, it was decided to employ 40 c.c. of 35 per cent Diodrast. Though this produced a relatively faint opacity of the amniotic fluid, the placenta was definitely demonstrated in the lower right uterine segment. An attempt at amniocystography was unsuccessful because of an insufficient quantity of contrast medium, but the delayed films showed a faint trace of Diodrast in the fetal bowel.

The patient received sixteen transfusions because of repeated bleeding and was delivered at eight and a half months by cesarean section. The fetus was living and well and the location of the placenta was confirmed.

CASE III (Fig. 5): The patient, a multipara, showed nothing unusual during her prenatal course except for rather frequent changes in fetal position and presentation as determined by manual palpation. She was admitted to the hospital at full term after losing approximately 250 c.c. of blood without pain. Preliminary roentgenograms without contrast material showed the placenta to be attached to the upper posterior portion of the uterus, thus eliminating the possibility of a placenta praevia. The fetal head, however, was seen to lie above the ma-



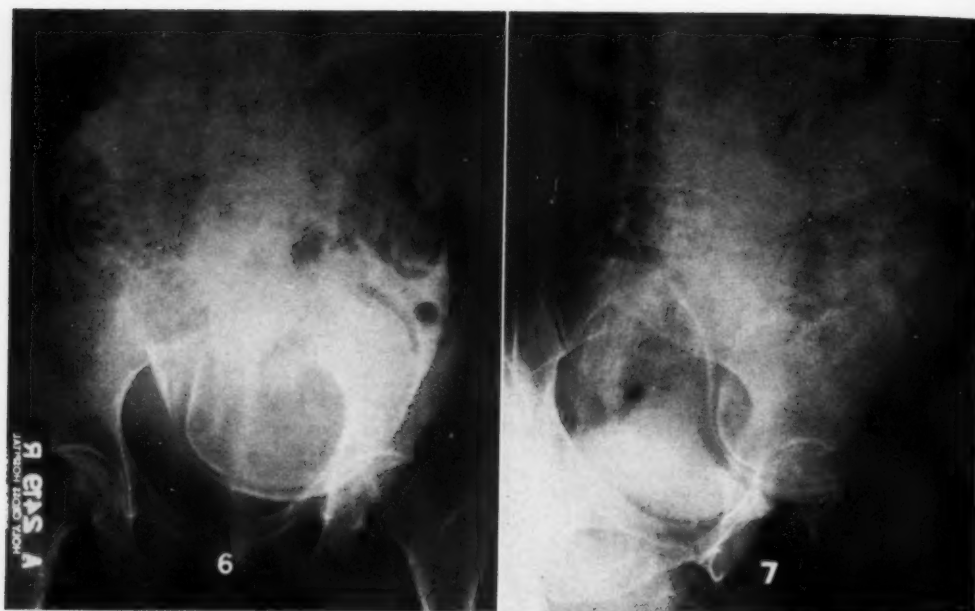
Fig. 5, Case III. Amniocystogram showing a mass in the lower right uterine wall displacing the fetal skull to the left. Note the relationship between the urinary bladder and the uterus, with the opacified bag of waters between the fetal skull and the bladder. An air cystogram would have given a false impression of central placenta praevia. Diodrast can be seen faintly in the fetal gut and the right kidney can be identified.

ternal pelvic inlet and was displaced forward and to the left.

Amniography, with 40 c.c. of 70 per cent Diodrast, showed the presence of a rounded tumor pressing against the amniotic sac at the junction of the middle and distal third of the sac on the right side. Here again the fetus swallowed the Diodrast immediately and it was seen in the bowel in larger quantities three hours later. A good delineation of the maternal urinary bladder was obtained, showing no placental shadow in the lower uterine segment.

Delivery was accomplished with difficulty from below. Immediately following expulsion of the fetus, the obstetrician introduced his hand into the uterus and identified a uterine fibroid in the area corresponding to the mass seen in the amniograms. The placenta was also found high in the left fundus.

CASE IV (Figs. 6-8): An elderly primipara showed no engagement of the fetal skull at term despite a very adequate pelvis. The preliminary films showed the skull pushed to the left and forward. Uterine puncture was performed three days later and no amniotic fluid could be aspirated. Another film was obtained, showing that the spine and head of the fetus had rotated from the maternal left flank to the right flank during the three-day in-



Figs. 6-8. Case IV.

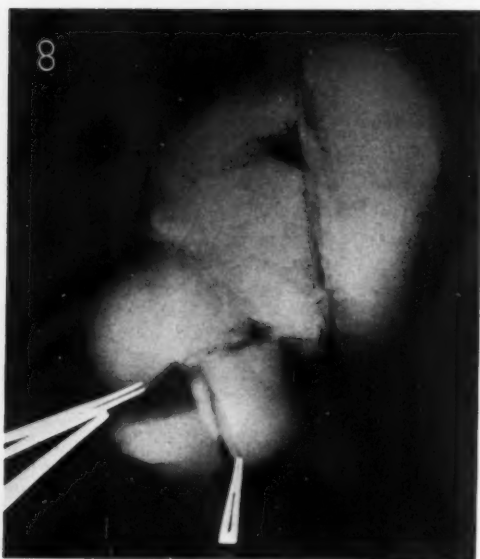


Fig. 6. Amniogram showing a tumor in the lower right uterine wall. This film was obtained immediately after injection and shows Diodrast in the fetal esophagus and stomach.

Fig. 7. Amniocystogram showing the filling defect produced by the lower right uterine tumor. Note the relation of the bladder to the uterus. The fetal bowel is filled with Diodrast.

Fig. 8. Roentgenogram of specimen following cesarean hysterectomy, showing leiomyoma in the lower right uterus.

hysterectomy. A roentgenogram of the removed uterus showed an attached fibroid tumor as discovered preoperatively.

CASE V: This is an unsuccessful case. The patient suffered from a voluminous hydramnios and was not yet at term. Preliminary films revealed a twin pregnancy. There was a strong clinical impression of fetal death which could not be confirmed roentgenographically. At the time of admission no 70 per cent Diodrast solution was available and, in fear of injecting too large a bulk of a foreign solution into the amniotic cavity, 60 c.c. of a 35 per cent solution was used. This proved to be completely inadequate in amount. No satisfactory opacification of the uterine contents was obtained. Should a similar case present itself today, I would urge removal of sufficient amniotic fluid to relieve the uterine distention and subsequent injection of at least 50 c.c. of 70 per cent Diodrast.

About two weeks following amniography one live and one still born twin were delivered spontaneously. Had the amniography been correctly performed, I am confident that diagnosis of one dead

terval. This illustrates the necessity of carefully determining the fetal position just previous to uterine puncture. Another injection site was selected, and the amniography was successful. The placenta was seen to be high on the left side of the uterus and again a tumor was identified in the lower right uterine segment. Rapid fetal swallowing was also observed.

On the basis of the information secured by the amniograms, it was decided to perform a cesarean



Figs. 9-11. Case VI.

Fig. 9. Amniography immediately following injection in a case of fetal death. The placenta is somewhat low in position in the left lower uterine wall. Note the thorough diffusion of Diodrast throughout the amniotic fluid. There is no fetal swallowing.

Fig. 10. Amniocystogram made four hours after injection. Absorption of the Diodrast is evidently taking place, as seen by excretion of opaque urine by the mother. Again there is no fetal swallowing activity.

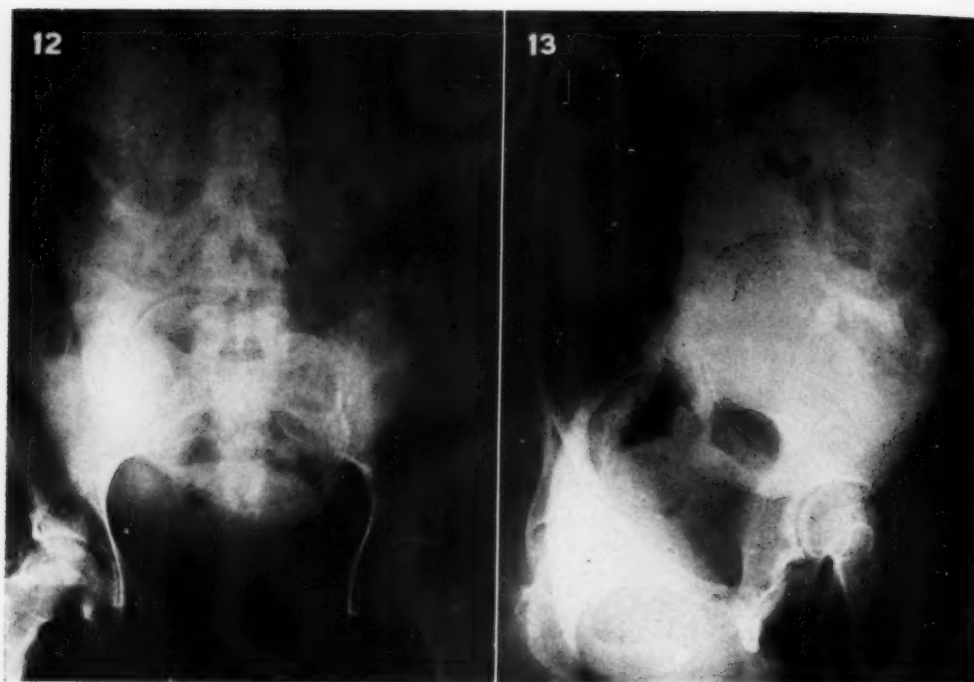
Fig. 11. Amniogram made twenty hours after injection. The Diodrast is almost completely absorbed and there is no evidence of fetal swallowing.



and one live fetus could have been made prenatally by studying the fetal swallowing activity.

CASE VI (Figs. 9-11): This was also a case of suspected fetal death in a term pregnancy. Plain roentgenograms were not diagnostic, however. Especially was there no definite overlapping of the cranial bones. When amniography was undertaken, no motion was imparted to the needle by the fetus, as usually occurs. The placenta was identified as somewhat low in the left posterior segment but could certainly not be qualified as a placenta praevia. It was also noticed that this was the only instance in which a uniform diffusion of Diodrast throughout the entire amniotic sac was obtained in the films immediately after the uterine puncture. No fetal swallowing was seen either immediately or at three hours or even twenty hours following amniography. A good amniocystogram was obtained at three hours, although the opacity of the Diodrast in the

urinary bladder was definitely less marked than in the presence of a living fetus. Diodrast could still be identified in the amniotic sac at twenty hours. The patient was delivered four days later of a dead, macerated fetus.



Figs. 12-14. Case VII.



CASE VII (Figs. 12-14): A primipara had several episodes of painless vaginal bleeding in the last month of pregnancy. Preliminary films showed a breech presentation, and it was thought that the placenta was located high in the anterior wall of the

Fig. 12. Amniogram made immediately after injection, showing an irregular filling defect in the lower right uterus representing a placenta praevia extending over the internal os.

Fig. 13. Oblique projection showing placenta praevia in the lower right posterior uterine segment. Film made immediately after injection.

Fig. 14. Fetus immediately after delivery by cesarean section, showing Diodrast in the fetal bowel.

uterus. Bleeding continued at irregular intervals, and three weeks following the original x-ray studies, another film was made, showing a vertex presentation. Amniography with the usual 40 c.c. of 70 per cent Diodrast showed a placenta implanted low in the right posterior uterus, partly covering the internal os. Thus the erroneous diagnosis of a high placenta was corrected. A cesarean section was performed confirming the amniographic localization.

Again a live, Diodrast-swallowing fetus could be seen and the amniocystogram was of definite help in diagnosing the placenta praevia. These cystograms, combined with the opaque amniotic fluid, can be studied to good advantage to show the normal thickness of the walls of the urinary bladder and uterus when in contact with each other, as well as the varying pathologic amounts of tissue when the placenta intervenes in this location. A film of the fetus immediately after birth was also obtained, showing Diodrast in the bowel.

CASE VIII (Fig. 15): In this case, bleeding began

at full term, accompanied by definite and regular uterine contractions. The placenta was found to be in the anterior wall of the uterus and did not appear to be attached in the lower uterine segment. On attempted amniography, the needle evidently entered the placenta and at first nothing but blood could be aspirated. The needle was therefore pushed down to the hilt and it was thought that a mixture of blood and amniotic fluid was withdrawn. The entire 40 c.c. of contrast medium was injected, and the patient experienced one of those systemic vasomotor types of reaction ordinarily seen with intravenous injections of Diodrast. Films were obtained showing that the injection was made directly into the substance of the placenta, where a small pool of the medium collected, apparently in one of the placental sinusoids. Films one-half hour later showed a very intense and opaque excretory urogram in the mother with physiologic dilatation of the renal and ureteral lumina characteristic of the late stages of pregnancy. The films also showed a duplication of the left urinary passages. No evidence of a fetal urogram could be recognized.

Spontaneous delivery occurred three days later. The fetus was alive and well and there was evidence of a partial separation of the placenta. The obstetrician was of the opinion that this separation antedated the amniography and was the cause of the bleeding prior to the examination.

CASE IX (Figs. 16 and 17): This patient began to suffer from bleeding and uterine cramps during the seventh month of pregnancy. Simple roentgenograms showed no definite and reliable placental image. Amniograms revealed the placenta to be located high in the left posterior wall of the uterus. In this instance, the usual 40 c.c. of 70 per cent Diodrast produced an unnecessarily high degree of opacity. The pregnant uterus was not very much enlarged and, no doubt, a smaller amount of contrast material would have rendered a correct diagnosis possible.

The uterine cramps present at the onset of the examination continued, and a live fetus was delivered less than twenty-four hours later. Here again, a diagnosis of premature separation was made following birth. The obstetrician believed that when the amniography was performed labor was already in progress and that the uterine puncture was not responsible for its onset.

COMMENT

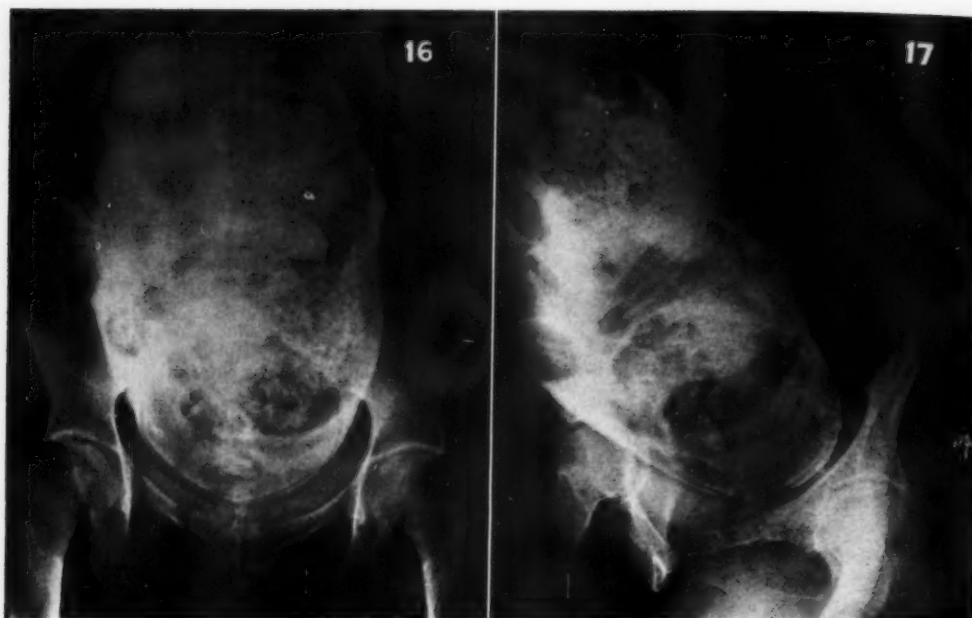
The author hopes that this report has shown both the diagnostic value and the harmlessness of amniography. It would certainly appear much less dangerous to use Diodrast in the amniotic cavity, whence it is slowly absorbed and eliminated, than to flood the circulatory system rapidly with this substance as is done in so



Fig. 15. Case VIII. Accidental injection of Diodrast into a placental sinusoid, with the resulting pyelogram. A pool of Diodrast in the placenta can be recognized over the upper border of the right sacro-iliac joint.

many recent intravenous and intra-arterial studies. In none of the cases in the series reported here except the one in which the placenta was mistakenly injected was the least trace of any systemic reaction observed. It is true that the series of cases is small, but all the recent workers with this technic have strongly emphasized that they have found no injurious effects of any kind in either the mother or fetus. It also appears that the normal course of pregnancy is not altered in any manner. In no instance does it appear that an unwanted induction of labor has followed amniography.

The immense amount of information gained by amniography is well illustrated by this small series. There would seem to be no other method of examination which gives at one time knowledge of so many aspects of pregnancy, fetal soft-tissue shadows, fetal gastrointestinal activity, fetal life or death, uterine malformations either



Figs. 16-17. Case IX.

Fig. 16. Amniocystogram in a pregnancy of seven and a half months. The placenta is high in the left lateral wall of the uterus. There is unnecessarily high opacity of the amniotic contents. Note Diodrast in the fetal alimentary tract.

Fig. 17. Amniocystogram. High left posterior placentation. Live fetus.

in the lumen or the walls of the uterus, placental implantation, and maternal excretory urography. Amniography can and does give knowledge of certain conditions which cannot be diagnosed clinically or by other radiographic means.

Amniography should be used only where it is justified. The chief indications are placenta praevia which cannot be diagnosed otherwise, suspected abnormalities of the fetus not recognized on preliminary films, suspected fetal death, suspected uterine tumors, and unexplained malpresentations.

Difficulties in technic may be assumed when the placenta appears to lie over the favorite site of puncture, that is, in the para-umbilical area of the maternal abdomen. The author has not yet dared to inject in the flanks for fear of puncturing the maternal bowel. It is, perhaps, unnecessary to obtain detailed films soon after uterine puncture, since the films obtained three hours following the puncture have proved to be the most informative.

In institutions with more facilities for study, amniography could conceivably be used to further our knowledge of certain aspects of obstetrical and fetal physiology and pathology.

SUMMARY

1. Amniography is a method of roentgen obstetrical diagnosis involving a transcutaneous puncture of the uterus through the maternal abdominal wall to inject varying quantities of Diodrast into the amniotic cavity. Although it has been used experimentally in early pregnancies, amniography in general clinical practice is done in the last trimester.

2. By using amniography, the radiologist can detect gross abnormalities of the fetal soft tissues which appear as negative shadows in the opacified amniotic fluid. Fetal sex might thus be detected before birth.

3. Every live fetus actively swallows the injected Diodrast and this appears in

the fetal digestive tract. Failure of swallowing presumably indicates fetal death. There is also a possibility of diagnosing gastrointestinal abnormalities of the fetus before birth.

4. Deformities of the uterine cavity can be diagnosed whether they represent deformities of the lumen, such as intraluminal septa, or deformities of the walls, such as uterine tumors.

5. The Diodrast is eliminated by the maternal urinary tract, providing an excretory urogram about three hours following uterine puncture. The relationship between the maternal urinary bladder and the lower uterine segment is well demonstrated at that time.

6. Placental implantation is shown very definitely at any stage of pregnancy and with any position or presentation of the fetus.

7. No evidence of fetal respiration was demonstrated in these studies.

8. Amniography appears to be harmless to mother and fetus and does not seem to induce labor.

9. Close co-operation between the obstetrician and the radiologist is essential.

10. The technic is described and 9 cases are presented.

NOTE: Grateful acknowledgment is expressed for the help and encouragement given to the author by the obstetrical staff of the Holy Cross Hospital, Detroit, Michigan. Without their co-operation, this work could never have been performed.

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SUMARIO

La Roentgenoamniografía: Valioso e Inocuo Auxiliar del Diagnóstico Obstétrico

La amniografía es un método de roentgenodiagnóstico obstétrico que comprende una punción transcutánea del útero a través de la pared abdominal para inyectar cantidades variables de Diodrasto en la cavidad amniótica. Aunque usada experimentalmente en el embarazo incipiente, en la práctica clínica general, la amniografía se utiliza en el último trimestre de la gestación.

Con la amniografía, el radiólogo puede descubrir anomalías macroscópicas de los tejidos blandos del feto, que toman forma de sombras negativas en el líquido amniótico opaco.

Todo feto viviente ingiere activamente el Diodrasto inyectado, el cual aparece en el tubo digestivo del feto. La falta de ingestión indica presuntamente muerte fetal. El método ofrece además la posibilidad de diagnosticar anomalías gastrointestinales en el feto antes del nacimiento.

Pueden diagnosticarse así también de-

formidades de la cavidad uterina, ya representen deformidades de la luz, como tabiques intraluminales, o de las paredes, como tumores uterinos.

El Diodrasto se elimina por el aparato urinario de la madre, permitiendo obtener un urograma excretorio unas tres horas después de la punción uterina. Esto revela bien la relación entre la vejiga urinaria y el segmento uterino inferior de la madre.

El método muestra con toda precisión la implantación de la placenta en cualquier periodo del embarazo y con cualquiera posición o presentación del feto.

En estos estudios, no se observaron signos de respiración fetal.

La amniografía parece ser inocua para la madre y para el feto y al parecer no induce el parto.

Es indispensable la más íntima cooperación entre el tocólogo y el radiólogo. Se presentan 9 casos.



Left Atrial Calcification

Report of Eight Cases Verified at Surgery for the Relief of Mitral Stenosis¹

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IN 1949, Epstein (1) reported 3 cases of left atrial calcification in rheumatic heart disease diagnosed roentgenologically during life and noted that only 2 other such cases appeared in the literature. Since that time numerous other reports have been published (2-6). Although somewhat less than half of the recorded cases have been accompanied by necropsy data

(2, 3), stress has been laid upon the probable endocardial location of the calcium.

Attention has been invited to the rheumatic endocardial lesion of MacCallum (7) as the probable calcium nidus (1). The frequency of the MacCallum lesion in rheumatic heart disease has also been noted, as well as the probable infrequency of calcific deposits within it (1, 8).

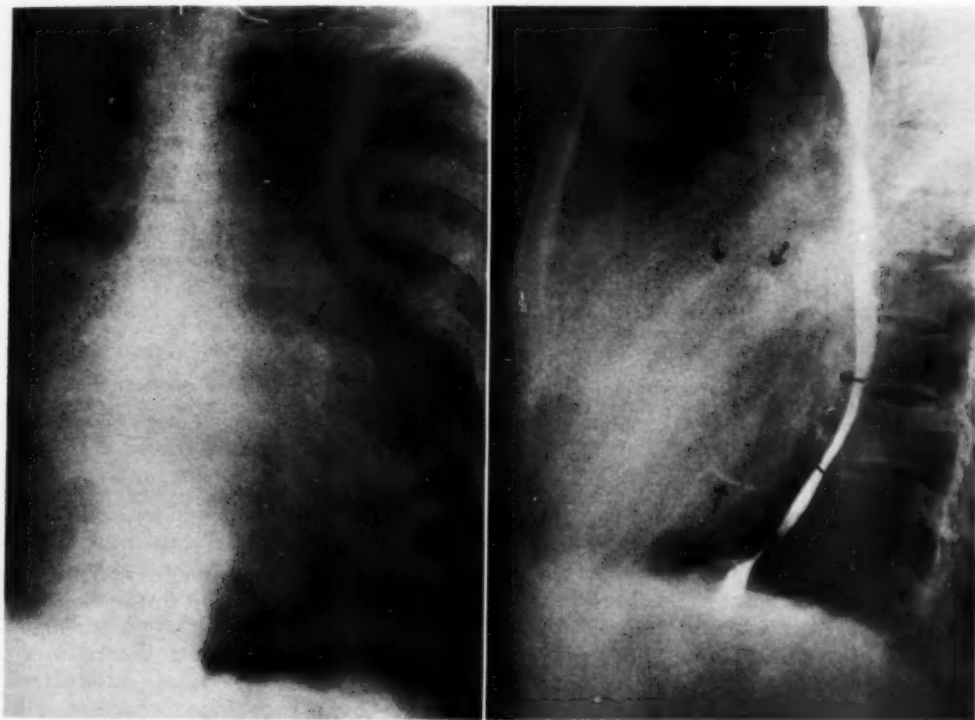


Fig. 1. Case 1: S. P., male, age 41 years.

Roentgen Findings: A solid triangular area of calcification in a location consistent with that of the left atrial appendage and assumed to represent a calcified thrombus. Linear calcification marginating the body of the left atrium believed compatible with intramural calcification or thrombus.

Surgical Findings: Left atrium and its appendage slightly enlarged and rock hard in consistency. The appendage was packed with a solid mass of calcium which could not be dislodged because of its direct continuity with mural calcification occupying all surfaces except the interatrial septum and the mitral valve.

Pathologic Study: No appendageal biopsy secured, since surgical approach was impossible through the appendage.

¹ From the Departments of Radiology and Pathology, the Hahnemann Medical College and Hospital, Philadelphia, Penna. Accepted for publication in September 1952.



Fig. 2. Case 2: A. B., female, age 45 years.

Roentgen Findings: A rather thick triangular area of calcification in the region of the apex of the left atrial appendage, continuous with thick, laminated calcification involving the body of the atrium. The thickness of the calcium deposit in the appendage and body of the atrium, as well as lamination in the latter, was considered highly suggestive of calcified thrombus.

Surgical Findings: Firm, shrunken, thrombotic left atrial appendage and extensively calcified thrombus involving palpable surfaces of the body of the atrium, which was appreciably enlarged and firm.

Pathological Study: No appendageal biopsy in this case, as surgical approach to the mitral valve was made through the left superior pulmonary vein.

As a basis for this report, x-ray film studies and the recorded fluoroscopic findings of 300 patients examined prior to mitral commissurotomy for the relief of mitral stenosis were reviewed. Eight cases of left atrial calcification were found. In all but 2 instances the tip of the atrial appendage was amputated at operation and submitted for pathologic study with special reference to the occurrence of calcification as demonstrated by the von Kossa stain method. Calcification (roentgenologically "visible" and surgically palpable) was encountered in the area of the auricular appendage in 5 of the 8 cases, and in 3 of these the detectable calcification was limited to that area. In the 3 remaining cases linear marginal calcification was demon-

strated in the body of the left atrium, but did not involve the appendage. Mitral annulus and valvular calcification are not included in this study.

The x-ray finding of a curved linear calcium density within the margin of the left artium in rheumatic heart disease seems consistent with intramural calcification. If the calcium deposition is laminated or relatively thick, the presence of calcified thrombus should be strongly considered. Obviously, calcified thrombus and intramural calcium could coexist, but roentgen recognition of this combination would seem rather uncertain.

The accompanying illustrations and the data in the legends are from the records of 8 cases of rheumatic heart disease surgi-

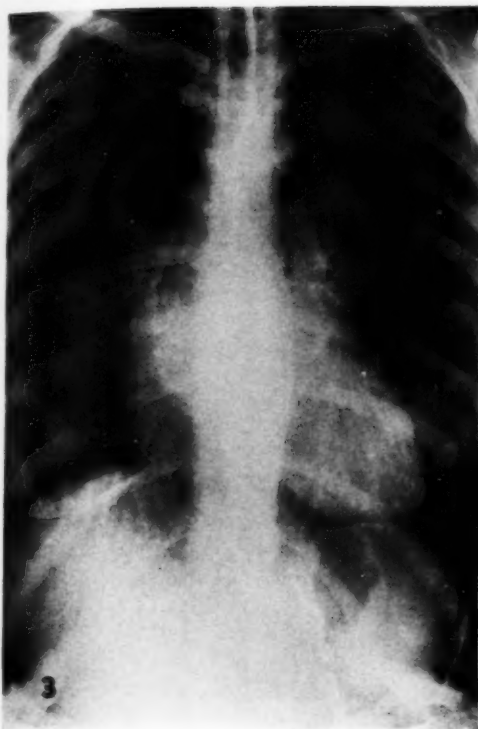


Fig. 3. Case 3: G. K., female, age 45 years.

Roentgen Findings: Fine, linear, non-laminated marginal calcification believed to be confined to the left atrial appendage and suggestive of intramural calcification.

Surgical Findings: A slightly enlarged, firm atrial appendage filled with a calcified thrombus.

Pathologic Study: Appendageal tip revealed extensive interstitial myocardial and subendocardial fibrosis with no evidence of intramural calcification.

Fig. 4. Case 4: H. R., female, age 36 years.

Roentgen Findings: Linear calcification, which marginates the left atrium, not including its appendageal region.

Surgical Findings: Moderately enlarged appendage; no thrombi.

Pathologic Study: Subendocardial and myocardial scarring in appendageal tip. No calcification.

Note: Since digital exploration of the interior of the left atrium failed to reveal thrombus, we can only conclude that the calcium deposit is intramural.

cally explored for the relief of mitral stenosis (finger exploration of the interior of the left atrium and mitral commissurotomy) (Figs. 1-8). To the best of our knowledge all of the 8 patients are still living.

DISCUSSION

Our small series substantiates the probable intramural location of calcium within the body of the left atrium when it is radiologically seen in a linear, non-laminated, marginal distribution. Relative thickness or lamination of the calcium deposition, as mentioned above, should suggest calcified thrombus. While the same reasoning may well apply to the appendageal portion

of the left atrium, thrombosis has a high incidence at this site and calcification in this area, regardless of distribution, may represent thrombus calcification. The possibility of this is suggested by Case 3.

The occurrence of intramural and/or thrombotic calcification within the left atrium is unusual and, if minimal, may easily be overlooked. The importance of careful fluoroscopy (adequate accommodation, fine focal spot, and limited field), as well as multiple film studies (postero-anterior, lateral, and oblique projections) for the demonstration of the location, extent, and probable nature of intra-atrial calcification cannot be overemphasized.

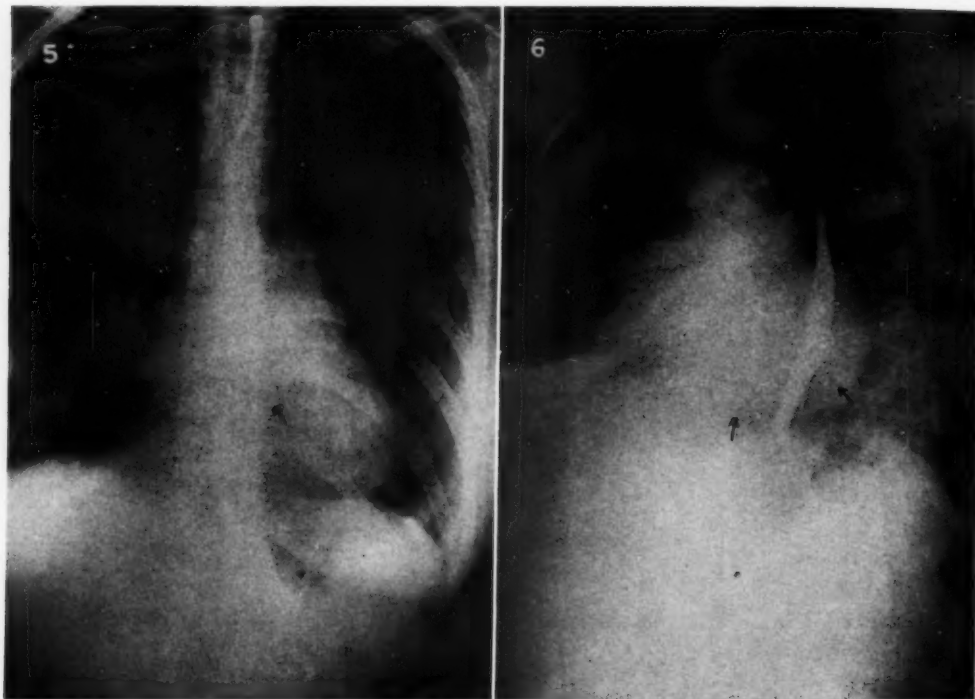


Fig. 5. Case 5: G. L., female, age 31 years.

Roentgen Findings: Linear marginal calcification of left atrium not evident in the vicinity of the appendage and believed to be consistent with intramural calcification.

Surgical Findings: Organized thrombus in slightly enlarged left atrial appendage. Intramural calcium felt in atrium.

Pathologic Study: Organized thrombus in the tip of the left atrial appendage, which is adherent to an extensively scarred endocardium, with marked subendocardial collagenous proliferation. No calcium was found in the amputated appendageal tip.

Fig. 6. Case 6: H. H., female, age 36 years.

Roentgen Finding: Calcification marginating the left atrium in linear fashion, not involving the appendageal area and believed to be consistent with intramural calcification.

Surgical Findings: Enlarged left atrial appendage without evidence of thrombosis or palpable calcium deposits. Firm intramural calcification felt in body of atrium.

Pathologic Study: Scarred appendage wall. No calcium detected in amputated appendageal tip.

Calcification in the left atrial appendage may assume characters simulating a calcified peribronchial lymph node but can probably be differentiated by multiple projection studies.

SUMMARY

1. Eight additional cases of left atrial calcification are reported.

2. Certain roentgenologic features are discussed which may serve to differentiate intramural and thrombotic calcifications.

3. Increasing search for these lesions will undoubtedly uncover more cases than have thus far been recognized.

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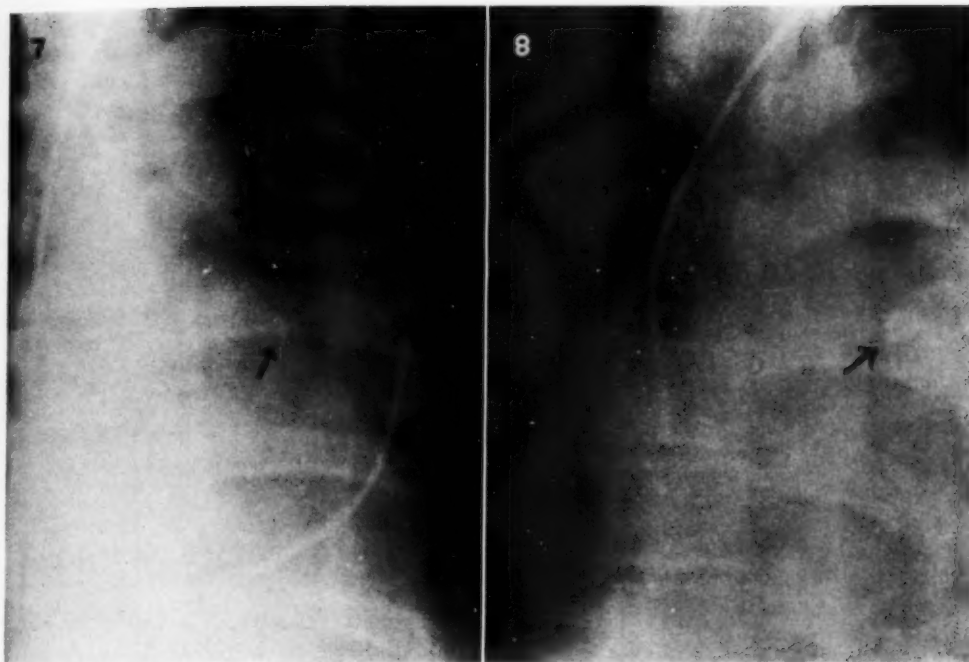


Fig. 7. Case 7: B. C., male, age 49 years.

Roentgen Finding: Fine, linear marginal calcification seen in a film study taken during cardiac catheterization and believed to be consistent with intramural calcium deposition near the apex of the atrial appendage.

Surgical Findings: Moderately enlarged atrial appendage without thrombosis. Consistency somewhat firm but no reference to palpable calcific deposits.

Pathologic Study: Subendocardial fibrosis and calcification of appreciable degree in amputated appendageal tip.

Fig. 8. Case 8: E. K., male, age 31 years.

Roentgen Findings: Rather dense area of amorphous calcification in a position consistent with the tip of the atrial appendage. The position and appearance of this calcium deposit might readily be interpreted as indicating a calcified peribronchial lymph node.

Surgical Findings: Firm, organized thrombus in a slightly enlarged appendage.

Pathologic Study: Extensive calcification in an organized adherent thrombus. No intramural calcification in amputated appendageal tip.

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SUMARIO

Calcificación de la Aurícula Izquierda: Presentación de Ocho Casos Comprobados al Operar para Alivio de una Estenosis Mitral

La existencia de calcificación intraparietal o trombótica dentro de la aurícula izquierda es inusual y, de ser mínima, puede fácilmente ser pasada por alto. No cabe exagerar la importancia de cuidadosos estudios roentgenoscópicos y multirradiográficos (proyecciones postero-anteriores, laterales y oblicuas) para descubrir la localización, la magnitud y la probable naturaleza de la calcificación.

El hallazgo roentgenológico de una condensación curvilínea de calcio dentro del borde de la aurícula izquierda en el reumatismo cardíaco parece compatible con la calcificación intraparietal. Si el depósito de calcio es laminado o relativamente grueso, hay que considerar seriamente la presencia de un trombo calcificado.

Publícanse grabados de 8 casos.

Malignant Lesions of the Tonsil¹

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IN ORDER TO evolve more efficient means of treatment, it is necessary to review, periodically, various cases and compare results with those in the literature. We have therefore prepared a review of all malignant lesions of the faucial tonsil treated in the Department of Deep X-ray

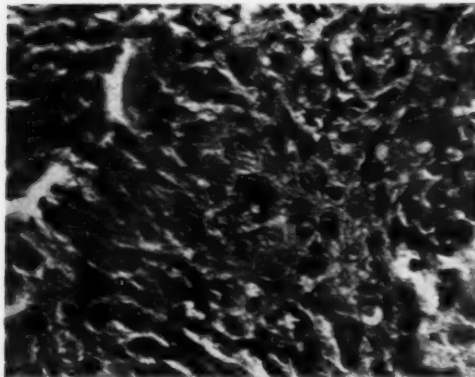


Fig. 1. Squamous-cell carcinoma of the tonsil prior to therapy. X370

Therapy of the University of Minnesota Hospitals during the period 1926 through 1950.

This group comprises 103 cases in all. Two cases have been eliminated because they were treated elsewhere before being seen here. We have, then, 101 cases to examine. Histologically, these fall into the following groups:

Squamous-cell carcinoma.....	72
Transitional-cell carcinoma.....	6
Undifferentiated carcinoma.....	2
Lymphoepithelioma.....	5
Lymphosarcoma.....	13
Leukemia.....	2
Hodgkin's disease.....	1

This distribution agrees satisfactorily with other series reported but is at variance with the opinion of Smith and Gault (13) that

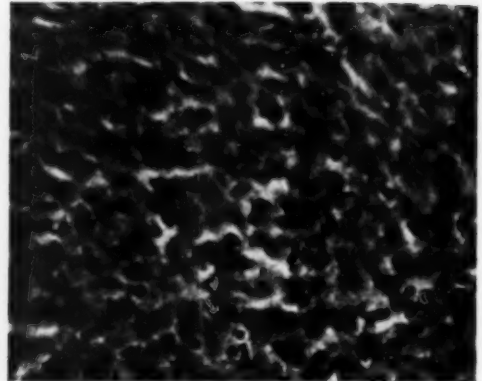


Fig. 2. Transitional-cell carcinoma of the tonsil prior to therapy. X370

the transitional-cell carcinoma is the most frequent lesion of the tonsil.

Pathologically, malignant lesions of the tonsil can be separated both grossly and microscopically. Grossly, the carcinomas are usually exophytic and frequently arise from the upper pole, spreading to the soft palate. They often ulcerate and form infiltrative lesions with hard rolled edges. Microscopically, they can be divided into three groups. The *squamous-cell carcinomas* (Fig. 1), are characterized by nests and cords of squamous cells invading normal tissues. They may show varying degrees of keratinization and epithelial pearl formation. Mitotic figures are not prominent ordinarily. The *transitional-cell carcinoma* (Fig. 2) is made up of cells of relatively uniform size, with clear cytoplasm and oval hyperchromatic nuclei. Mitotic figures vary greatly in number, and keratinization or epithelial pearl formation is not seen. The tumor tends to grow in solid sheets and invades widely. The *undifferentiated carcinoma* is a microscopically indeterminant form which can be classified neither as a squamous-cell car-

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cinoma nor as a true transitional-cell carcinoma. It is usually of a high grade malignancy.

Of less frequent occurrence is the lymphoepithelioma, which is felt by many to be a carcinoma of either the transitional or undifferentiated type. This lesion makes

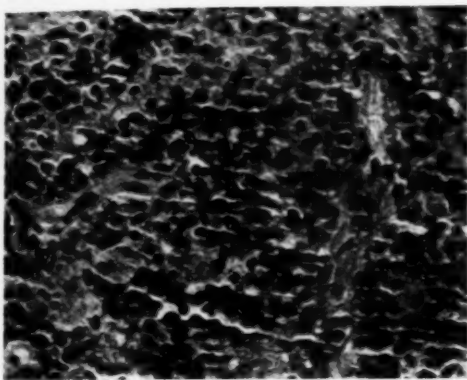


Fig. 3. Lymphoepithelioma of the tonsil prior to therapy. $\times 370$

up 4 to 8 per cent of the total group (2). However, because of its different clinical behavior, it is often considered as a separate lesion. As described by Regaud, it is characterized by cords of clear epithelial cells infiltrated by numerous lymphocytes (Fig. 3). It metastasizes to lungs, liver, and bones, and carries to the metastases its distinctive histologic pattern. Grossly the tumors are smooth and sometimes lobulated. The cervical lymph nodes are almost always involved. The lymphoepitheliomas frequently ulcerate after attaining a large size, and metastasize rapidly and widely.

The lymphosarcomas ordinarily do not ulcerate but become very large and frequently produce symptoms of obstruction. There is often bilateral cervical lymph-node involvement. The tonsil may be the original site of disease, with rapid generalization, but at least one series shows a high incidence of five-year survivals (7). Microscopically (Fig. 4) these lesions are indistinguishable from other lymphosarcomatous lesions involving lymph nodes.

Leukemia and Hodgkin's disease in the tonsil are likewise microscopically indis-

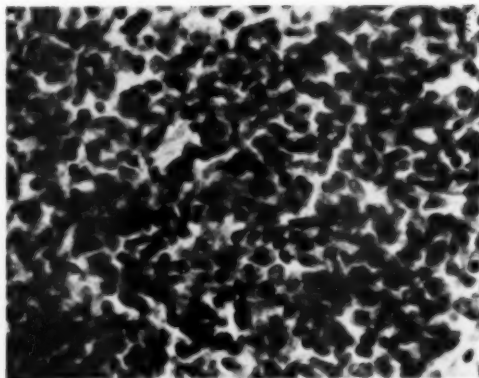


Fig. 4. Lymphosarcoma of the tonsil prior to therapy. $\times 370$

tinguishable from these lesions elsewhere, and will not be described in detail here.

We have made no attempt to correlate the over-all incidence of cancer of tonsil with that of cancer as a whole in this hospital. According to other reports, cancer of the tonsil comprises 1.5 to 3.0 per cent of all cancers and is the second most common form of cancer of the upper air passages, cancer of the larynx being the most common (1, 10, 11, 12). Carcinomas occur more frequently in men in the sixth to eighth decades, only 10 per cent occurring in women (1, 10, 11, 12, 15). In our over-all group, including all diagnoses, we find 16 per cent of cases in women and 84 per cent in men. The average age was 62.9 years. If, however, we exclude the 13 cases of lymphosarcoma, 2 cases of leukemia, and the 1 case of Hodgkin's disease, the figures are: 75 males (88 per cent) and 10 females (12 per cent), with an average age of about 61 years. Approximately one-third of the cases of lymphosarcoma and lymphoepithelioma are said to be in women. Of our 13 patients with lymphosarcoma, 5 (38 per cent) were females and 7 (62 per cent) males, with an average age of 64 years, the latter figure being much higher than that reported by others (1, 7).

The clinical evolution of cancer of the tonsil is usually quite insidious, and not infrequently (46 per cent) the first symptom noted is a mass in the neck (15). A growth in the mouth as the presenting symp-

tom is relatively infrequent (9 per cent) (15). Usually there is a complaint of discomfort or a foreign-body sensation. Pain is infrequent except in advanced cases, and otalgia and dysphagia are usually late occurrences except in lymphosarcoma, where obstruction may occur quite early (1, 7). In our series, the duration of symptoms varied from one or two days to as long as two years prior to treatment. Several cases were found on routine pathological examination of tissue following tonsillectomy.

The etiology of these lesions is obscure, but it can be stated that a multitude of traumatic insults and inflammatory conditions which may predispose to malignant growth occur in the tonsil, as well as in the rest of the oral cavity. Poor oral hygiene and smoking may play prominent roles. In 2 of our cases there was a known leukoplakia of the tonsillar area prior to the onset of a frank carcinoma.

The diagnosis can usually be made easily by visual inspection, but biopsy is essential. Palpation is also necessary to delineate the extent of the lesion and to help identify lymph-node metastases. The possibility of tuberculous or syphilitic ulceration must be excluded.

The age incidence is of particular importance in these lesions. The average age in our series is 62.9 years, and, as can be seen from the accompanying figures, the greatest number of cases occur in the seventh and eighth decades. The youngest patient was 32 years of age and the oldest was 86 at the time of treatment. Due to the advanced age of most of the patients, relatively few have an opportunity to survive five years after treatment.

Age Incidence by Decades

0-10.....	0
10-20.....	0
20-30.....	0
30-40.....	8
40-50.....	8
50-60.....	13
60-70.....	34
70-80.....	33
80-90.....	5

It is generally felt that cancer of the tonsil is best treated by radiotherapy—external irradiation, teloradium therapy, interstitial radiation, or a combination of these methods. Most authors agree that surgery has nothing to offer in the treatment of the primary lesion because of the high operative mortality and generally poor results. Martin and Sugarbaker (10) conclude that “despite these theoretical advantages [accessibility and lack of vital function], surgery offers little in the treatment of this disease, since the primary lesions are seldom small or sufficiently localized in the tonsillar fossa to be operable when first seen.” After a thorough review of the surgical literature, they concluded, also, that “in the final analysis, one must conclude from its history that the operative treatment of cancer of the tonsil justifies Despons’ epithet of ‘surgery of despair’.” The possibility of radical neck dissection must be considered, and in selected cases where the primary lesion is controlled it may well be indicated. Ackerman and del Regato (1) consider it to be contraindicated because of the high position of the involved nodes and the fact that nodes usually react rather favorably to irradiation. Taylor and Nathanson (14), however, believe that radical neck dissection may be indicated in occasional cases.

Our method of treatment has been almost exclusively irradiation, although a few patients have had surgery of one type or another. Prior to 1936, the usual procedure was to deliver 800 to 1,000 r in air to each of two fields (usually lateral fields), with 200 kv.p. and 0.5 to 1.0 mm. copper filter. The treatment was given in from seven to fourteen days. After the advent of the Coutard technics, the number of fields was changed to four, with three on the involved side plus an opposite lateral. The dosage then ranged from 900 to 1,500 r in air to each field in twenty-one to thirty days, with either 200 or 220 kv.p., 1.0 mm. copper filter, and h.v.l. 1.0 to 1.7 mm. copper. These dosages produce estimated tumor doses of 2,600 to 4,400 r. Radon implantation for supplemental ir-

TABLE I: SURVIVALS IN TOTAL GROUP OF MALIGNANT LESIONS OF THE TONSIL

Year	No. of Cases	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1926	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1928	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1929	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1930	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1932	1*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1933	2	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
1934	4	3	3	3	3	3	3	3	2	2	2	0	0	0	0	0	0	0
1935	3	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
1936	7	4	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	0
1937	8	7	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1938	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1939	10	6	5	4	3	3	2	2	2	1	1	1	0	0	0	0	0	0
1940	7	4	3	3	2	2	2	1	1	1	1	0	0	0	0	0	0	0
1941	3	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
1942	8	5	4	4	2	2	1	1	1	1	1	0	0	0	0	0	0	0
1943	3	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
1944	6*	3	3	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1945	6	4	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
1946	3	2	2	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0
1947	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	7	4	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	0
1949	5	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	0
1950	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Cases	101	101	98	93	86	84	81	75	69	66	58	55	48	38	36	28	21	0
Survived		62	39	33	24	22	18	15	13	9	8	3	2	2	2	2	1	0
Percent survival		61	40	35	28	26	22	20	19	14	14	5	4	5	5	7	5	

* Two patients who received only one treatment and failed to return for completion of therapy.

radiation has been used since 1926, the usual dose being calculated as 5,000 gamma-ray roentgens with even distribution of the implants, both the primary lesion and involved nodes being implanted as necessary. In general, the dose delivered to the lymphosarcomas has been similar to that for the carcinomas, and of the 13 tumors in this group, 6 were implanted with radon. Of the 3 patients who survived five or more years, all received radon implants. Of the 6 who survived three years, only these same 3 had been implanted, suggesting that this procedure should be done in all cases in which the disease is not too far advanced. Many cases were already generalized by the time implantation was desirable, and in such cases it is obviously not feasible.

The prognosis in malignant lesions of the tonsil is not markedly different from that for other forms of intra-oral cancer, but does vary between the carcinomas, lymphoepitheliomas, and lymphosarcomas. In the over-all picture (Table I) we find

three-year and five-year survivals of 35 per cent and 26 per cent, respectively, which compare favorably with those for series reported elsewhere (Table VI) (3-12, 15).

The 39 per cent three-year survival reported by Berven (3, 4) covers only patients treated with a radium pack and local radium to the lesion. In an earlier series treated with irradiation, he had no three-year survivals, but primary healing was obtained in 25 per cent of 28 cases. Coutard's series, showing 26 per cent three-year and 23 per cent five-year survivals, included only epitheliomas. His later report of 32 per cent five-year survivals (21 of 65 patients) likewise dealt only with epitheliomas (5, 6). Duffy's figures are of interest, as his group was analyzed in greater detail (8). He included 45 patients with operable metastases, of whom 7 (16 per cent) survived three years, while of 46 patients without metastasis 15 (33 per cent) survived three years. In his total group of 176 patients, there were 32 (18

TABLE II: SURVIVALS IN CASES OF CARCINOMA
(Lymphosarcoma, leukemia, and Hodgkin's disease excluded)

Year	No. of Cases	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1926	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1928	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1929	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1930	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1932	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1933	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1934	4	3	3	3	3	3	3	3	2	2	2	2	0	0	0	0	0	0
1935	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1936	7	4	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	0
1937	8	7	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1938	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1939	9	5	4	3	2	2	1	1	1	1	1	1	0	0	0	0	0	0
1940	6	3	2	2	2	2	2	2	1	1	1	1	0	0	0	0	0	0
1941	3	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
1942	8	5	4	4	2	2	1	1	1	1	1	1	0	0	0	0	0	0
1943	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1944	6	3	3	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1945	4	3	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1946	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1947	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cases	85	85	82	78	75	73	71	67	61	60	52	49	43	34	32	24	17	0
Survived		52	31	26	20	18	14	11	9	7	6	3	2	2	2	2	1	0
Per cent survival		61	38	33	27	25	20	16	15	12	11	6	5	6	6	8	6	

per cent) three-year survivals. Schall (12) based his report on a group of 230 patients, of whom 13 were untreated and 99 were omitted from the statistical analysis because of insufficient treatment (palliative). Of the remaining 118, 23 (18 per cent) survived for varying periods. Other series by Mattick (11), Walker and Schulz (15), and Martin and Sugarbaker (10) show similar results (Table VI). Martin and Sugarbaker reported 157 cases, of which 9 were eliminated either because the patient was lost without recurrence (2 cases) or because of death from causes other than cancer (7 cases). Of their remaining 148 patients, 26 (18 per cent) were well five years. Seventy-five per cent of their cases showed metastasis at the time of treatment.

In our series (Table I) we have included all patients treated primarily in the University of Minnesota Hospitals. Two patients were eliminated because they had been treated elsewhere by irradiation. All

patients lost to follow-up are considered as being dead from cancer. If we exclude 2 patients who received only one treatment and then failed to return for completion of therapy and 4 who died of causes other than cancer (no cancer postmortem) we have a corrected five-year survival rate of 28 per cent. Women are said to have a better prognosis than men, but in our series this was not true, the survival rates for the two sexes being almost identical.

Of the 13 patients in the lymphosarcoma group, 6 (46 per cent) survived three years and 3 of a possible 10 (30 per cent) survived five years. Of the 5 patients with lymphoepithelioma, 4 (80 per cent) survived three years and 3 (60 per cent) five years. No patient with transitional-cell carcinoma lived more than two years from the onset of treatment. One of the 2 patients with leukemia has survived two years to date; the other died of generalized disease eleven months after initial treatments. In the 1 case of Hodgkin's dis-

ease the survival period was ten years but repeated treatments were given to the abdomen, inguinal regions, and axillae several years following treatment of the tonsil. Examining Table II, which includes all of the carcinomas and lymphoepitheliomas, we find three-year and five-year survival rates of 33 per cent and 25 per cent, respectively.

TABLE III: PRESENCE OR ABSENCE OF METASTASES

Lesion	No. With Metastases	No. Without Metastases or Local Extension	No. with Local Extension Without Metastases	Total
Carcinoma	58	13	9	80
Lymphosarcoma	9	3	1	13
Lymphoepithelioma	2	2	1	5
Leukemia	2	0	0	2
Hodgkin's disease	1	0	0	0
TOTAL	72	18	11	101

The presence or absence of metastases is known to affect the survival rates, the absence of palpable cervical lymph nodes indicating a better prognosis. We have analyzed our cases from the standpoint of results with and without metastases or local extension (Table III). In the carcinoma group there were 13 patients who had no evidence of local extension or metastases. Of these 13, only 12 could have survived three years, and 6 (50 per cent) did so. Of the 9 patients with local extension but no metastases, all 9 could have survived five years, and we find that 5 (56 per cent) survived three years and 4 (45 per cent) survived five years. Considering the lymphosarcomas, we find that 1 of 3 patients with no evidence of metastases or local extension survived five years. The one patient with local extension but no metastases survived seven years. In the lymphoepithelioma group, the one patient with local extension but no metastases survived seven years, while 1 of the 2 with neither metastases nor local extension survived five years. Local extension of the lesion, at least within limits, does not seem to compromise the survival rates.

TABLE IV: CARCINOMA SURVIVAL RATES WITH AND WITHOUT METASTASES

Group*	3-Year Survival		5-Year Survival	
	No. of Patients	No. Survived	No. of Patients	No. Survived
A	12	6(50%)	12	4(33%)
B	9	5(56%)	9	4(45%)
C	51	11(21%)	47	7(15%)

*A. Without metastases or local extension of the primary lesion.

B. Without metastases, with local extension of the primary lesion.

C. Metastases with or without local extension of the primary lesion.

Patients with demonstrable metastases do not have as good a survival rate (Table IV), but it is obvious that a large number of these patients survive at least one year (Tables I and II). Irradiation is, therefore, a good palliative measure and ought to be used whenever possible to relieve obstruction and enable patients to eat and get along without undue suffering. Cervical nodes frequently respond quite well, since of the total patients surviving three years (33) 18 showed evidence of metastases to the cervical nodes prior to treatment. Of the 22 patients surviving five years, 12 (55 per cent) were in the group showing no metastases and 10 (45 per cent) in the group which showed evidence of metastases at the time treatment was instituted.

Evidence of persistence of either the primary lesion or of the lymph-node metastases after completion of treatment was found in 33 carcinoma patients, but in only 7 patients did metastatic nodes appear subsequent to completion of therapy (Table V). One patient with lymphoepithelioma had a recurrence (or a second primary) fifteen years after treatment. The recurrence was microscopically indistinguishable from the original lesion and occupied the same site. Two transitional-cell carcinomas showed metastatic nodes subsequent to treatment, as did 4 lymphosarcomas, 1 case of leukemia, and the single case of Hodgkin's disease. In most of these last three groups the disease was generalized.

Surgical procedures of various types have been used in these patients both before

TABLE V: EVIDENCE OF PERSISTENCE OR RECURRENCE

	A	B	C
Carcinoma (squamous)	12	33	7
Lymphoepithelioma	0	1	0
Transitional-cell carcinoma	0	0	2
Lymphosarcoma	0	0	4
Leukemia	0	0	1
Hodgkin's disease	0	0	1

A. Persistence of primary lesion at completion of therapy.

B. Persistence or recurrence of primary or nodes in treated areas.

C. Development of nodes after treatment.

There were two cases of radionecrosis of the mandible.

Radiation therapy of these lesions is a severe strain on the general condition of the patient and measures must be taken to assure adequate food and fluid intake, especially during the height of the reaction. These include appropriate oral hygiene, the use of liquid petrolatum or lozenges for dry mouth, pontocaine sprays or codeine for relief of pain, the use of a water-soluble

TABLE VI: COMPARISON OF RESULTS

Author	3-Year Survivals			5-Year Survivals		
	Total No. Patients	No. Survived	Per Cent Survived	Total No. Patients	No. Survived	Per Cent Survived
Berven	18	7	39			
Coutard	46	12	26	46	11	23
				65	21	32
Mattick	162	17	10			
	36	9	25 without metastases			
	126	8	6 with metastases			
Walker and Schulz	56	14	25	39	6	15
	34	7	21 with metastases	23	2	9
	22	7	32 without metastases	16	4	25
	28	9	32 Supervoltage	21	5	24
	28	5	18 Hi-Voltage	18	1	6
Duffy	176	32	18			
	46	15	33 without metastases			
	18	5	28 with metastases after admission			
	45	7	15 with operable metastases			
	67	5	7 with inoperable metastases			
Martin and Sugarbaker				148	26	18
Stenstrom	93	33	35	84	22	26

and after irradiation therapy. Eight patients had tonsillectomies, with lesions being discovered at routine pathological examination of the tonsils. Two patients had neck dissections prior to irradiation and 4 following irradiation. Two carotid ligations were done subsequent to irradiation. Local removal of a mass in the neck was done on 2 patients, and partial mandibulectomy for radionecrosis of the mandible was performed in 2 cases.

Complications encountered range from the usual dry mouth, mucositis, and epithelitis to frank hemorrhage from the tumor site in 4 cases (after completion of therapy). Only 2 patients with carcinoma showed distant metastases, to the liver in both instances, and one of these died eight years after treatment. One patient with carcinoma had a local recurrence in the hypopharynx six years after treatment.

base ointment for the moist epidermitis, the pretreatment removal of teeth in heavily irradiated areas in order to prevent radiation necrosis of the mandible, and antibiotics for control of infection. The newer chlorophyll mouth washes have proved effective in helping control the offensive odor associated with far-advanced lesions during the height of the reaction. Where metastases are being treated, the larynx should be protected in order to prevent possible necrosis of the laryngeal cartilages. Hemorrhage due to deep slough and necrosis may require ligation of the external carotid artery and its branches. Recurrence is usually handled by additional radon implantation and occasionally further external irradiation.

In 3 patients second primary lesions developed subsequent to the treatment of the tonsil. One patient had a subsequent

squamous-cell carcinoma of the lip and a basal-cell carcinoma of the cheek, while another had an adenocarcinoma of an oil gland and, in addition, a carcinoma in the opposite tonsil developing four years after the original treatment. One patient died of a squamous-cell carcinoma of the lung five years after treatment of the tonsil (autopsy).

SUMMARY AND CONCLUSIONS

One hundred and three cases of cancer of the tonsil treated by irradiation have been reviewed. The three-year and five-year survival rates compare favorably with those in other series reported in the literature.

A high tumor dose is required, but it is unwise to insist upon a definite value, as patients vary widely in tolerance, making individual evaluation necessary.

The addition of radon implantation, with careful distribution, is a desirable method of increasing the tumor dose to the primary lesion and of controlling lymph-node metastases.

Involvement of neighboring structures, if not too extensive and without lymph-node metastases, does not compromise the chances for survival.

Small lesions with no evidence of metastases have a better long-term prognosis.

Definite palliation of considerable duration is often obtained in advanced lesions if the treatment is discontinued before the reaction becomes too severe.

While dissection of enlarged submaxillary and cervical lymph nodes may be indicated when the primary lesion is con-

trolled, it should be noted that such metastases may be eradicated with irradiation.

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SUMARIO

Lesiones Malignas de la Amígdala

Esta comunicación tiene por base 101 tumores malignos de las amígdalas, tratados en el período de 1926-1950. La serie comprendió 72 carcinomas escamocelulares, 6 carcinomas de células de transición, 5 linfopiteliomas, 13 linfosarcomas, 2 casos de leucemia y 1 de enfermedad de Hodgkin. El tratamiento fué con los rayos X,

complementados con implantes de radón en los casos más recientes. Obtuvieron sobrevivencias de tres años y de cinco años en 35 y 26 por ciento, respectivamente, del total, lo cual se compara favorablemente con los resultados obtenidos por otros.

Las lesiones pequeñas sin signos de

metástasis ofrecen un pronóstico mejor a largo plazo, pero la invasión moderada de los tejidos cercanos sin metástasis en los ganglios linfáticos no rescinde las probabilidades de sobrevivencia. Obtiénese a menudo mitigación bien definida de mucha duración en las lesiones avanzadas si se

discontinúa el tratamiento antes de que la reacción se vuelva demasiado grave. Aunque puede estar indicada la disección de los ganglios submaxilares y cervicales al dominar la lesión amigdalina primaria, debe hacerse notar que esas metástasis son erradicables con la irradiación.



Late Effects of Thorotrast in Tissues¹

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THOROTRAST IS A radiopaque medium widely employed in recent years, notably in angiography. Its use, however, is followed at times by damaging effects on tissues which become apparent in years rather than months, stemming most frequently from its accidental perivascular deposition (3). Rarely, its deposition within the cells of the reticulo-endothelial system leads to aplastic anemia (10, 16, 27) and neoplastic growth (16). In both instances, the effects are the result of the radioactive properties of the thorium salt.

Thorotrast is a 25 per cent solution, by volume, of colloidal thorium dioxide in a dextrin medium. The element thorium contained in this preparation is the parent substance of a series of compounds constituting one of the three naturally occurring radioactive families, the others being radium and actinium. It has an estimated half-life of 1.34 billion years (13). The radioactive decay of the thorium series releases alpha particles, beta rays, and gamma rays. Biological effects are due chiefly to the alpha particles and to a lesser extent to the beta radiations. The gamma activity, while small and appearing at the end of the disintegration series, is useful in localizing and measuring thorium deposits by apparatus of the Geiger-Müller type. For such a study, 25 to 75 c.c. of Thorotrast are used. Taft (29, 30) estimated that the gamma-ray activity of 75 c.c. of thorotrast is equivalent to 1.37 microgram of radium. The alpha radiation effect in an ampule of freshly prepared solution, according to Schlund (25), is equal to 1 microgram of radium. It can readily be appreciated, therefore, that the activity of the average dose of Thoro-

trast is quite comparable to the estimated 2 micrograms of radium salts shown by Martland to have caused serious radium poisoning. Martland (17, 18), moreover, in his studies of radium poisoning of persons engaged in the painting of luminous watch dials, noted that salts of mesothorium and radiothorium constituted 80 per cent of some of the material used. The maximum permissible amount of radium salt for deposition within the body is 0.1 microgram while that of thorium salt is 0.5 microgram (34). The amount of thorium dioxide in one vial of 25 c.c. is at least 4 gm.

The total radioactivity of thorium dioxide solution, to which attention was drawn by Orr, Popoff, Rosedale, and Stephenson (22), decreases over a period of five years and then begins to rise due to the fact that sufficient radiothorium²²⁸ has broken down to form other members of this radioactive family which are strong alpha emitters. The resultant total radioactivity after ten years is 54 per cent of the activity of an original solution. This activity continues to increase, reaching its peak in the next fifteen years. This seems to explain why in some instances serious complications develop after a latent period of a decade or more.

CASE REPORT

A. G. W., a 53-year-old white male, was first admitted to the U. S. Naval Hospital, Bethesda, Md., Oct. 20, 1948, complaining of a slowly enlarging mass in his right arm, present for eighteen months. Weakness of the arm and numbness of the right thumb and the first two fingers had been followed by induration and enlargement of the antecubital region, which later became painful. Treatment with diathermy, light massage, and active exercises resulted in moderate subjective improvement, but a

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Fig. 1. Preoperative roentgenogram showing opaque mass in soft tissues of arm, resembling myositis ossificans.

year later, October 1949, the patient returned because of progression of symptoms.

Examination revealed a firm mass measuring $15 \times 5 \times 3$ cm., involving the distal portion of the brachialis muscle and antecubital region of the right arm. Extension of the elbow was limited to 160 degrees and resulted in disappearance of the radial pulse. Radiologically, there was an opacity involving the upper arm and elbow. This area appeared feathery, especially at its upper pole, and seemed to infiltrate the muscle bundles. There was no evidence of bony trabeculation. The lesion suggested myositis ossificans (Fig. 1).

The mechanical disability and local symptoms indicated surgical intervention, and at operation a firm grayish-yellow mass of tissue was found, completely enveloping the median nerve and the brachial artery in the right antecubital fossa. The tissue cut with a gritty sensation. Pathological examination revealed atrophic skeletal muscle partially replaced by large amounts of dense, relatively acellular fibrous tissue. Between the muscle bundles and in the fibrous stroma were scattered masses of coarse, faintly basophilic, highly refractile granules (Figs. 2 and 3). These granules were largely concentrated

in macrophages, although some were free in the stroma. They did not stain with von Kossa's stain for phosphate nor give Perls' reaction for iron. In a few areas, irregular masses of calcium were present. The pathological diagnosis was "Thorotrast in skeletal muscle." Confirmation was obtained by subjecting the ashed specimen to spectrographic analysis, which was positive for thorium.

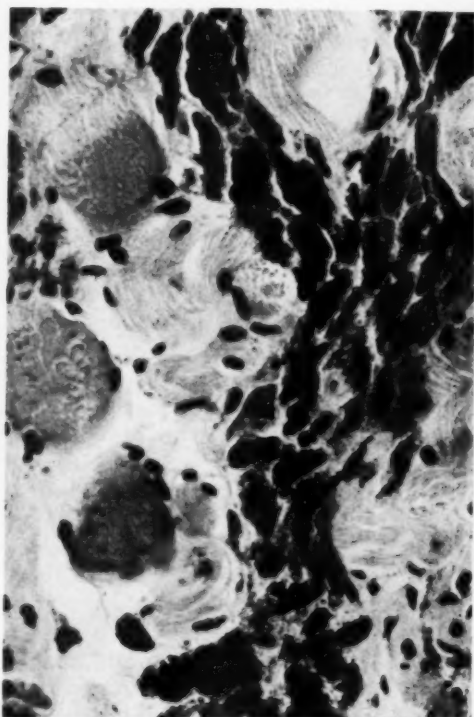


Fig. 2. Thorotrast granules, chiefly intracellular, lying between skeletal muscle fibers.

The patient was questioned again, and a history of Thorotrast injection was deduced. Twelve years prior to his admission to the Naval Hospital, he had been studied at a large clinic for peripheral vascular disease of eighteen years duration. In the course of this study, the vessels of the upper extremities were injected with Thorotrast. Immediately following the injection into the right arm, local swelling had occurred, with severe pain at the injection site. By the following day the pain had disappeared and required no further attention. Except for occasional vague sensations referable to the right upper extremity, the patient felt well for the following twelve years.

Radioactivity Studies: Postoperatively, after it was known that the patient had Thorotrast deposits in his arm, he was referred to the radioisotope laboratory. Measurements of the antecubital region of the right arm by means of Geiger-Müller

counter tubes revealed significant radioactivity. This area corresponded to the opacity seen in postoperative x-ray films. A quantitative estimate, obtained with the aid of a phantom containing a vial of 25 c.c. of Thorotrast, revealed that approximately 20 to 25 per cent of the gamma-ray activity of a single vial of Thorotrast still remained in the soft tissue of the right arm. Palpable nodes were found



Fig. 3. Dense acellular fibrous tissue reaction about the radioactive granules of thorium dioxide.

in the right axilla, and these also contained a significant amount of radiation. A small amount of activity was detected over the liver and spleen, being slightly more intense over the spleen.

Measurements were made with laboratory types of Geiger-Müller tubes, four different counter arrangements giving approximately the same results. This equipment consisted of a pack of non-shielded 1/4-inch gamma-type tubes, and 1/4-inch, 3/4-inch and 1 1/8-inch shielded end-window Geiger-Müller counter tubes.

Radioautographs of the tissue showed alpha particle tracks arising from the area of the intracellular granules of Thorotrast (Fig. 4).

It was difficult from the x-ray films to determine the exact amount of Thorotrast-infiltrated tissue still remaining in the arm. Direct measurements from ashed portions of the specimen in an internal sample type vibrating reed counting device indi-



Fig. 4. Birth of alpha particles from thorotrast granules.

cated activities as high as the equivalent of 42 micrograms per gram of tissue, of original thorium dioxide. This is in the range of a hundredfold the permissible amount for the entire body. The equipment and method of surface localization are an adaptation from those which are used in clinical tracer studies with radioiodine (I^{131}) and radiogallium.

DISCUSSION

As early as 1932, the Council on Pharmacy and Chemistry of the American Medical Association warned against the intravenous use of Thorotrast because of its radioactivity (1). A similar, but stronger, resolution was voiced by a French Commission, which stated that radioactive substances, in spite of their immediate harmlessness, should be completely forbidden (4). Amory and Bunch, in 1948, reported 7 cases of radiologically demonstrable perivascular deposition of Thorotrast, 6 in the neck and 1 in the antecubital region (3). Five of this group showed

symptoms due to the effect of scarring several years after introduction of the Thorotrast. Two were asymptomatic three and six months respectively after injection. In 2 cases in which material was obtained at operation, the tissues showed definite alpha activity. One case was initially diagnosed as myositis ossificans.

Fleming recorded a case of painful nodules developing in both antecubital fossae five months after injection with Thorotrast and noted the pathological findings (6). In another case, coming to necropsy five months after the injection of Thorotrast, he noted the presence of coarse granules in the liver, spleen, and lymph nodes. In both cases radioactivity of the tissues was demonstrable. A similar case of nodules in the antecubital fossa was noted by Ziffren three years following injection (33). In another case of his, pain developed in the groin following femoral injection of Thorotrast. A year later, biopsy of a lymph node of the groin disclosed granules within the phagocytes, fibrosis, and endothelial hyperplasia. In Mora's case, a painful breast nodule developed thirteen months following intramammary injection of Thorotrast (20). Histologic studies showed large granules surrounded by scar tissue.

Laborde reported a painful, ulcerated induration of the buttocks that appeared ten years following Thorotrast inoculation for vertebral rheumatism (10). The overlying skin showed a typical radiodermatitis. X-ray studies revealed considerable opaque matter in the buttocks. In addition, the patient was extremely fatigued, and severe anemia ascribed to radiation was found. Histologic findings similar to those previously described were noted. Similarly, Spier, *et al.* reported a fatal case of aplastic anemia ten years after Thorotrast injection (27). At necropsy, the liver, spleen, and bone marrow contained Thorotrast. Again radioactivity, chiefly of the alpha type, was demonstrated in the tissues. These studies are in opposition to those of Yater and Coe, who noted no serious ill effects from Thorotrast in 286 cases (32).

Roussy, *et al.* were the first to discover that Thorotrast was capable of producing sarcoma in rats following intraperitoneal injection (24). Selbie confirmed their results (26), and Gricoureff produced osteosarcoma following intravenous inoculation of rabbits (7). MacMahon, Murphy, and Bates reported the development of an endothelial-cell sarcoma of the liver in a 68-year-old female twelve years after Thorotrast injection (16). Thorotrast was found in the form of a large deposit immediately adjacent to the tumor and also in the spleen, bone marrow, and lymph nodes. The marrow was markedly atrophic.

The elimination of Thorotrast and the related problem of storage have been extensively studied. The finding of deposits in the cells of the reticulo-endothelial system years after injection has already been noted. Orr, *et al.*, while studying the storage of Thorotrast in rabbits, noted its deposition in the reticulo-endothelial system with no elimination over a four-year period (22). They observed hemopoietic depression and damage to the liver and spleen. Alpha particles and gamma-ray activity were detected in the tissues. Wen noted a similar deposition of Thorotrast within the reticulo-endothelial system of rabbits six months after injection (31). In man, Elman and Haworth observed Thorotrast storage within the reticulo-endothelial system at necropsy five weeks after the injection (5). Jacobson noted similar findings five years after an intravenous injection of 75 c.c. (8). The approximate gamma-ray activity was equivalent to that of 0.3 microgram of radium. Leipert found 60 per cent of the thorium in the liver and spleen of two patients who died a few days after injection (14, 15). In another case, he found 90 per cent in the same organs sixty days after injection. In studies in dogs, he could find no traces of thorium in the urine or feces. Naegeli and Lauche performed histologic studies in dogs five years after injection and concluded that thorium remained in the body forever (21). They found damage to the regional lymph nodes of the liver. Taft

reported necropsy findings six weeks after injection. The liver and spleen were primarily involved, and significant gamma-ray activity was present. Stenstrom studied elimination in man six and seven years after injection (28). He found slight gamma-ray activity in the feces but concluded, in part, that "excretion of thorium after intravenous injection of thorotrast in patients has not been discovered as yet, and these studies show a great portion of the thorium must have still remained in the tissues of the two patients who received injections six and seven years prior to measurements."

SUMMARY AND CONCLUSIONS

From these studies it is apparent that Thorotrast is responsible for serious disease, which is often late in appearance. The continued, increasing radioactivity due to the breakdown of thorium dioxide is responsible for these effects. For the most part the radioactive material is retained in the cells of the reticulo-endothelial system. The commonest complications are due to its accidental perivascular deposition, leading to destruction and scarring of the surrounding tissues. Rarely, its concentration within the reticulo-endothelial system results in an aplastic anemia or the formation of malignant neoplasms.

We believe that over a period of years, due to its cumulative radioactivity, Thorotrast probably will be responsible for more cases similar to that described.

The possibility of Thorotrast should be considered whenever a radiopaque mass is visualized in the soft tissues, especially of the neck and antecubital regions. In cases diagnosed as myositis ossificans roentgenologically, disease due to Thorotrast should be considered and Geiger-Müller studies should be instituted. Sufficiently accurate determinations may be obtained with any laboratory type Geiger-Müller counter.

At operation, the affected tissues are firm, yellowish-gray and cut with a gritty resistance. Histologically, Thorotrast is suggested by the finding of coarse, uniform,

highly refractile granules that are faintly basophilic and lie in a dense acellular fibrous stroma.

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SUMARIO

Efectos Tardíos del Torotrasto en los Tejidos

Descríbese un caso en el que, a los doce años de la inyección de torotrasto para la angiografía, se descubrió en el brazo derecho una tumefacción de tejido blando que sugería radiológicamente miositis osificante. Al examen patológico, la misma resultó ser músculo esquelético atrófico reemplazado en parte por tejido fibroso y relativamente acelular. Entre los fascículos musculares y en el estroma fibroso había masas esparcidas de gránulos groseros, débilmente basófilos y muy refráctiles. El análisis espectrográfico del ejemplar en ceniza resultó positivo para bario. Por las mediciones realizadas en el laboratorio de radioisotopos, calculóse que todavía restaban en los tejidos del brazo aproximadamente 20 a 25 por ciento de la

actividad de los rayos gamma de un frasco de torotrasto. También se descubrió actividad en los ganglios linfáticos de la axila derecha y sobre el hígado y el bazo.

Repásase la literatura relativa a los efectos del torotrasto inyectado. Esos efectos, que aparecen tardíamente, son imputables a la mayor radioactividad creada por la desintegración del bióxido de bario. En su mayor parte, la substancia radioactiva es retenida en las células del sistema reticuloendotelial. La complicación más habitual procede de los depósitos perivasculares, que conducen a la destrucción y cicatrización del tejido circundante. Raramente, puede presentarse anemia aplásica o neoplasia maligna.

The Lethal Dose of Whole-Body Tantalum¹⁸² Gamma Irradiation for the Burro (*Equus asinus asinus*)¹

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THE RESPONSE of man and animals to whole-body irradiation is of major interest. Due to obvious experimental difficulties, observations of large animals have been limited in comparison to those on small laboratory species. Tullis *et al.* (1) have reported lethal dose investigations with swine, and Prosser *et al.* (2) mention a lethal dose study with goats but give no details. Some data are also becoming available from various field experiments performed in conjunction with atomic bomb tests (3, 4). So far as is known, there have been reported no other similar studies with animals having a tissue mass or body volume approaching that of man. There is little or no information dealing with such interrelated problems as significance of depth dosage, time-intensity relationships, gamma rays *vs.* x-rays, radiosensitivity of various species, extrapolation from small to large animals, and sublethal physiological effects.

The burro (*Equus asinus asinus*) was chosen for initial whole-body irradiation investigations because, in addition to having a body volume near that of man, it is particularly suitable for work performance tests, detailed blood studies, and clinical observations. In order that a base line be established to which sublethal physiological effects could be related, it was necessary to establish the LD 50/30, which is defined as the amount of radiation required to kill 50 per cent of the exposed animals within thirty days. This report describes the methods used and the values thereby obtained.

MATERIALS AND METHODS

Exposure Field: The exposure device, which is unique, has been described in detail by Wilding *et al.* (5). It consists essentially of a circular concrete paddock 50 ft. in diameter, with nineteen derricks, for support of the radioactive sources, distributed in a concentric hexagonal pattern. At each of these locations is a deep, water-filled cistern from which the charge may be elevated by remote control to activate the field. The animals are permitted to wander at will over the exposure "pad" but are prevented from getting within 2 1/2 ft. of the charge by appropriate fencing. Under these conditions it has been determined experimentally that the photon flux is reasonably uniform throughout the field when all the charges are elevated.

In this study the field was loaded with approximately 40 curies of tantalum¹⁸² at each charge site. During exposure, the radioactive sources were lifted to a level midway, dorsoventrally, of the chest of the burro. Water was always available for the animals and they were fed when it was necessary to deactivate the field for a short time.

Animals: The 90 burros used in this study were chosen from a band of about 250 animals maintained under similar conditions. All were non-pregnant females selected for uniformity of weight, ranging from 115 to 177 kg. They were from two to three and a half years old. None of the experimental animals had any acute or chronic disease so far as could be determined clinically. For the experi-

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RESULTS AND DISCUSSION

TABLE I: LETHAL RESPONSE OF BURROS TO WHOLE-BODY IRRADIATION (10 animals in each group)

Dose (r)	Mortality (%)	Dose Rate (r/hr)	Exposure Time (hr.)
300	0	22.2	13.5
400	0	22.7	17.5
530	0	22.1	24.0
570	0	18.3	31.0
640	20	18.1	35.3
645	60	22.4	28.8
700	100	17.9	39.0
820	100	22.6	36.2
Control	0	0	0

mental study, the burros were lotted into uniform groups of 10.

Exposure Procedure: At first, five lots of animals were exposed to irradiation doses covering the range 300 to 820 r, in order to bracket the estimated LD 50/30 zone. One month later, on the basis of results obtained, an additional three lots were exposed at 570, 640 and 700 r, to characterize further the LD 50/30 point. Animals in the first five groups were observed fifteen days prior to exposure. For the other animals, the pre-irradiation observation period was only two or three days. All received an ample quantity of good quality grass hay with a light mixture of ladino clover, and salt and water *ad libitum*.

A surcingle with closable pockets on the sides was placed on each animal of the group shortly before exposure. A recently calibrated, 1,000-r Victoreen thimble chamber was enclosed in latex rubber and placed in each pocket. By this method the uniformity of the dose given to each animal could be estimated. It was determined from the results in the eight exposure groups that the burros effectively randomized themselves and that all individuals received essentially the same exposure. The 10 animals were then turned into the exposure field and the sources raised. The dose received was governed by the length of time the burros were left in the activated field; the longest exposure was thirty-nine hours and the shortest thirteen and a half hours. When the total dose was well under 1,000 r, it was possible to read the

thimble chambers carried by the animals once at the end of the exposure. In other cases, the field had to be deactivated in order to read and recharge the thimble chambers. Thus the larger doses were given in two fractions, usually broken by half an hour. Once, however, a four-hour

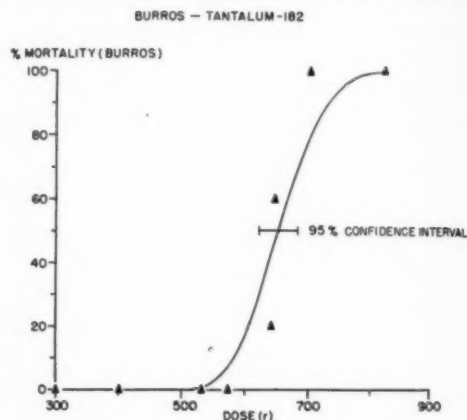


Fig. 1. Sigmoid curve derived from the data in Table I and fitted by the Bliss Fisher probit method. The LD/50/30 is 651 r and the confidence interval is 621 to 683 r.

interruption was caused by a mechanical failure in the exposure device.

For thirty days following exposure, each group of burros was maintained in a separate observation pen. Thereafter, animals in good condition were turned to pasture. Those not able to care for themselves were kept in the pens until convalescent. During the observation period, temperatures and weights were recorded daily and a blood sample was taken from each animal once a week. Necropsies were done upon all animals that died. The hematologic and pathologic observations will be published later.

Dosimetry: At the outset of the experiment it had been decided that the readings of the 1,000-r chambers would be interpreted as the skin dose received by the animal. It was soon apparent, however, that the instruments were energy-dependent even though a 4-mm. lucite protective cap was placed over the sensitive tip of the chamber to produce saturation back-scatter. Therefore, since the con-

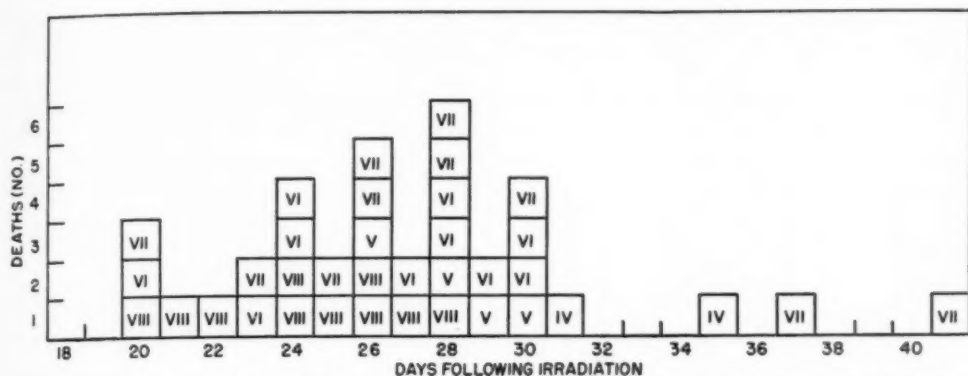


Fig. 2. Time sequence of deaths following irradiation. V = 640 r. VI = 645 r. VII = 700 r. VIII = 820 r.

tribution of the scattered radiation to the total dose was unknown, it was decided to use the air dose at the time of the exposure.

The dose rate, which was determined by Victoreen thimble chambers of various capacities and corrected by a standardized⁶ 25-r Victoreen thimble chamber, is presented in Table I. The flux of the tantalum¹⁸² gamma-ray radiation field was measured at different times and found to agree with the accepted 117-day half-life value.

In order to approximate the dosage received at a mid-point in the burro, a lucite phantom was constructed. Based on the average dimensions of the burro, the phantom was built to be 39 cm. wide, 93 cm. long, and 45 cm. deep, and was curved at the bottom to represent roughly the body shape. It was left open at the top for ease in filling with water. The same Victoreen chambers as described above were enclosed in latex rubber and suspended within the water-filled phantom at various locations for measurements. It was determined that 70 per cent of the entering dose could be measured along the mid-line of the phantom, 19.5 cm. from the lateral walls, when all nineteen radioactive sources were contributing to the flux of the radiation field.

Table I shows the lethal response as a function of dose received, at the end of thirty days following the mid-point of the exposure period. Figure 1 is the sigmoid

curve which is obtained when these data are fitted by the Bliss-Fisher probit method (6). This yields an LD 50/30 value of 651 r and confidence interval⁷ of 621 to 683 r. There is no basis for comparison of this value for the burro with LD 50 values for other species reported in the literature. For the most part, the methods used here differ from those of others in one or more of the following respects: (a) in the size and species of animal used; (b) in the fact that the radiation flux was delivered uniformly from all sides rather than as a beam; (c) in the use of gamma-ray spectrum instead of x-rays; (d) in the relatively low dose rate. Studies are presently underway to evaluate the relative importance of some of these factors.

The time pattern of deaths is shown in Figure 2. As may be noted, there was a range of twenty to forty-one days, with a close grouping about the mean survival time, which was calculated to be twenty-six and a half days. This is somewhat longer than that found with laboratory animals but is in general agreement with the observations made on the Hiroshima atomic bomb casualties (7).

SUMMARY AND CONCLUSIONS

1. Eighty sexually mature female burros (*Equus asinus asinus*) were exposed, in groups of 10 animals each, to 300, 400,

⁶ National Bureau of Standards.

⁷ 95 per cent

530, 570, 640, 645, 700, and 820 r of tantalum¹⁸² whole-body gamma irradiation upon a specially constructed exposure field at a rate of 18 to 23 r per hour.

2. The LD 50/30 value was estimated to be 651 r, with a 95 per cent confidence interval of 621 to 683 r.

3. The mean survival time of all animals dying of acute whole-body irradiation was 26.5 days. The range of survival time was twenty to forty-one days.

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SUMARIO

La Dosis Letal de Irradiación Gamma del Tantalio¹⁸² para Todo el Cuerpo en el Burro (*Equus asinus asinus*)

Ochenta burras sexualmente maduras fueron expuestas, en grupos compuestos de 10 animales cada uno, a 300, 400, 530, 570, 640, 645, 700 y 820 r de irradiación gamma del tantalio a todo el cuerpo, a razón de 18 a 23 r por hora, sobre un campo de exposición construido *ad hoc*.

Calculóse que el valor 50/30 de DL (es decir, la cantidad de irradiación requerida para matar 50 por ciento de los animales expuestos en término de treinta días) representaba 651 r, correspondiendo

95 por ciento a límites extremos de 621 a 683 r.

El tiempo de sobrevivencia media de todos los animales que murieron a consecuencia de la irradiación aguda de todo el cuerpo fué de 26.5 días, variando de veinte a cuarenta y un días.

Se escogió al burro para estos estudios, por aproximarse el volumen de su cuerpo al del hombre y además por prestarse en particular para otros estudios de los efectos de la radiación.



Plastic Vaginal Cylinder

Accessory to the Expanding Cervico-Uterine Radium Applicator¹

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IN THE MANAGEMENT of carcinoma of the cervix, unless the multiple distributions of the radium intensities in the uterine canal and vaginal vault are controlled both mechanically and physically, thereby facilitating accurate duplication of the dose in gamma roentgens (or their equivalent) at two or more fixed distant pelvic points (A/B r coefficient of absorption), the clinical reporting of results and the technical evaluation and comparison of the different technics are of questionable statistical value.

In previous studies we presented data relating to the photometric radiation effects upon slow emulsion films of supposedly standard radium technics and observed that there was a greater lack of uniformity and distribution of the pelvic radiation intensities than we had anticipated. This was found to be due in part to faulty positioning of the radium capsules, although at the time of our application we, like other therapists, had egotistically assumed confidence in our ability to pack accurately and fix permanently these loose radium sources in relation to the primary and potential malignant parametrial lesions.

Routine radiographic examinations of the pelvis soon revealed that these wandering radium capsules were drifting into dangerous positions, toward the bladder or rectum. In the interest of protection of the normal structures, we removed and re-applied the radium in an attempt to correct these faulty positions, usually without success. Vaginal deformities or uterine displacements, or both, added to the difficulty of these reapplications. Our only alternative, if we hoped to avoid "hot-spots" and the probable development of slow healing

ulcers or vaginal fistulas, was to reduce the total radium dose when the radiographic examination indicated that the loose capsules continued to remain in a position dangerous to normal pelvic tissues.

In Figure 1 three removable radium tubes are shown, completely filling the uterine canal, with six vertical capsules uniformly distributed throughout the vaginal vault, designed, when fully expanded, to partially surround the lesion at the cervical os as well as to irradiate directly the parametrial fields. The two lateral vaginal capsules are removable. When the plastic cylinder, B, is attached to the protruding handle of the radium applicator it not only protects the outer half of the vaginal mucosa, but also serves as a fulcrum for effective and safer control of the radium sources in the mid-pelvic corridor between the bladder and rectum.

In Figure 2, the expanding radium sources are viewed in the opposite lateral position within the pelvis. The respective ends, G, of the vaginal capsules are protected with lead and 2 mm. of brass. The radium needles have an over-all length of 19 mm. and an active radium length of 12 mm. Added protection of the rectum and bladder is obtained with increase of the distance between the active end sources of the radium needle and the superior and inferior surfaces of the capsules containing the 10 mg. radium needles.

Figure 3 is a proposed radium dosage chart (1 cm. scale) for diagrammatically recording the distribution of the radium intensities when 90 mg. of radium is employed in a single unit holder. The scintillation counter measurements in gamma roentgens delivered per hour at the various points shown in the diagram were

¹ From the DePaul Hospital and the Barnard Free Skin and Cancer Hospital, St. Louis, Mo. Accepted for publication in October 1952.

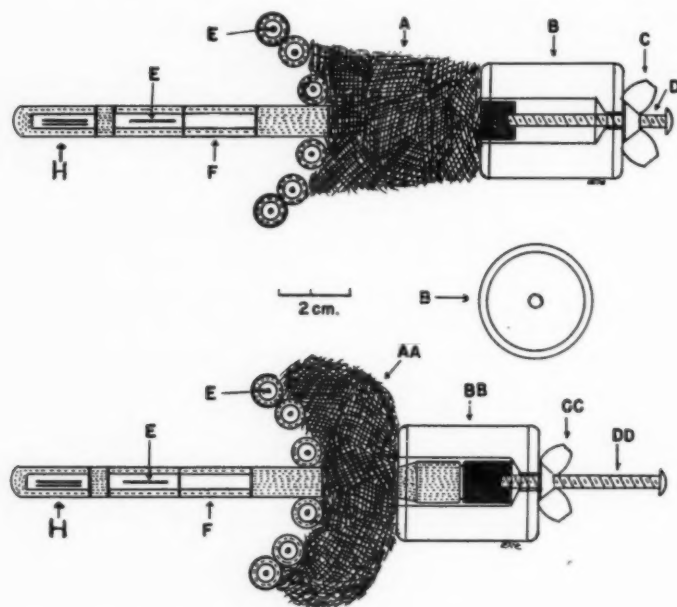


Fig. 1. Single unit type of expanding radium applicator with vaginal plastic cylinder attachment, anterior view. A. Vaginal gauze packing impregnated with barium sulfate. B. Plastic vaginal cylinder (3 × 5 cm.). C. Wing nut. D. Screw bolt. E. Each capsule contains a 10-mg. radium needle (12 mm. active radium sources) except the proximal uterine canal capsule, F, which contains no radium, but the distal cervical stem at the fundus, H, contains 20 mg. instead of 10 mg. Each of the six vertical vaginal capsules contains 10 mg. of radium. When wing nut (CC) is screwed forward on bolt (DD) the plastic vaginal cylinder (BB) compresses the barium gauze packing (AA) laterally along the vaginal vault.

made by Ter-Pogossian.² This new form of radiation measurement facilitates calculation of the total radium dose at points "A" and "B," in gamma roentgens per hour, by multiplying the predetermined intensity rate factors at these and other points in the pelvic fields by the number of applied radium hours, not milligram hours. For example, the total gamma roentgen dose at point "B" can be determined as shown in Fig. 3 (72 hours × 29 r/hr. = 2,088 r). If, instead of a single continuous application of radium, the dose is fractionated at intervals of ten to fourteen days, then the initial application as shown on the dosage chart (49.5 hours × 29 r/hr. = 1,435 gamma roentgens) is repeated (51.5 hours × 29 r/hr. = 1,494 gamma roentgens) and the sum of these radium

doses at point "B" will total 2,929 gamma roentgens.

To this may be added the roentgen tumor tissue dose delivered to the mid-parametrial fields, 2,100 r through four 6 × 12 cm. ports for a combined total radium and roentgen intensity of 5,029 gamma roentgens at point "B." Additional roentgen radiation to point "B" may be supplemented by external irradiation delivered through four or eight lateral oblique ports for increasing the gamma roentgen dose from 5,029 r to 6,000 r throughout the lateral walls of the pelvis. Similar calculations can be determined for point "A" (101 hours × 63 r/hr.) = 6,363 gamma roentgens.

Two centimeters inferior to the radium sources in the uterine canal, toward the anterior rectal wall, the gamma roentgen radium intensities ranged from 36 to 46 r

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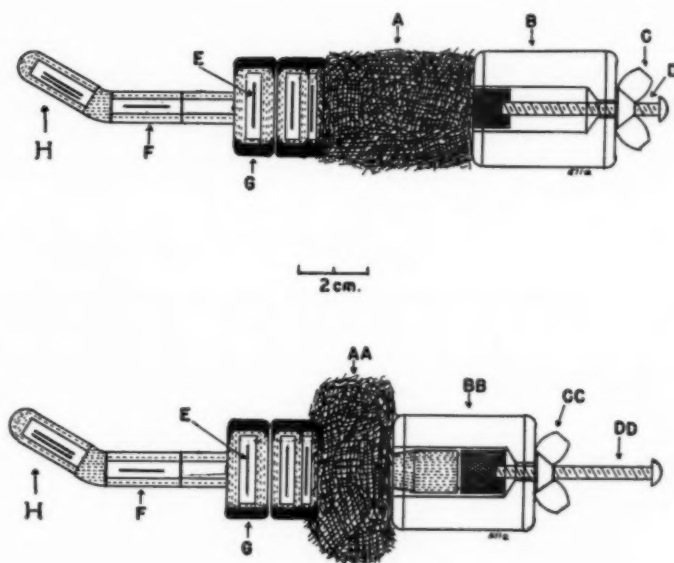


Fig. 2. Single unit type of expanding radium applicator with vaginal plastic cylinder attachment, lateral view. The lead filtered ends of the vertical vaginal capsules (G) and distance between the active radium sources of the radium needles and the bladder and rectal walls serve to reduce the radiation intensity reaching the bladder and rectum. The filtration factor of the 10 mg. radium needles is 0.5 mm. platinum and the walls of the capsules and tubes 2 mm. brass, total equivalent filtration 1 mm. platinum. The filtration of the walls of the two outer vaginal colpostats is increased by 1 mm. of brass.

per hour. Clinical experience throughout the past four years, with few exceptions, has indicated that this amount can be tolerated by the rectal walls provided the position of the applicator remains radiographically parallel and approximately 2 cm. above the rectal mucosa or below the bladder walls.

COMMENT

1. Radium and roentgen therapy techniques for the lethal control of potentially malignant distant pelvic lymphatics and lymph nodes in the treatment of carcinoma of the cervix have not been universally standardized as to quantity and quality.

2. When the primary lesion is localized at the cervical os, even a modified radium technic or surgical removal might suffice for effecting a cure. In the more advanced groups, more effective radiation management is required.

3. In an effort to compare the advantages and disadvantages of the various

treatment methods proposed during the past several decades, including the so-called Stockholm, Manchester, Paris, and other loose-capsule procedures similar to the hard- and soft-sponge-rubber technics, we arbitrarily proposed, as a basis for evaluating the effectiveness of these methods, ten clinical and physical criteria, namely, simplicity, flexibility, reliability, uniformity of dose, control of radium sources, correction of deformities, protection of normal structures, self-protection, predetermined dosage measurements, and duplication of the radiation procedures.

4. The science and art of the practice of radiation therapy requires experience and judgment in the selection of the proper radium application technic to meet individualized problems. The single unit type of radium application employed during the past five years has proved to be very flexible for individualizing the dose, but occasionally even this method fails to meet the requirements of a far-advanced

or extremely large infiltrating crater type of pelvic cancer. However, in our experience, the use of loose radium sources has contributed little toward minimizing post-irradiation injuries when an adequate radium dose was administered.

5. Except in the more advanced Stage

6. When a single unit type of cervico-uterine applicator is employed and the radium dose in gamma roentgens per hour has been standardized by means of controlled scintillation counter measurements at various vital points in the pelvis, as for example at "A" and "B," respectively

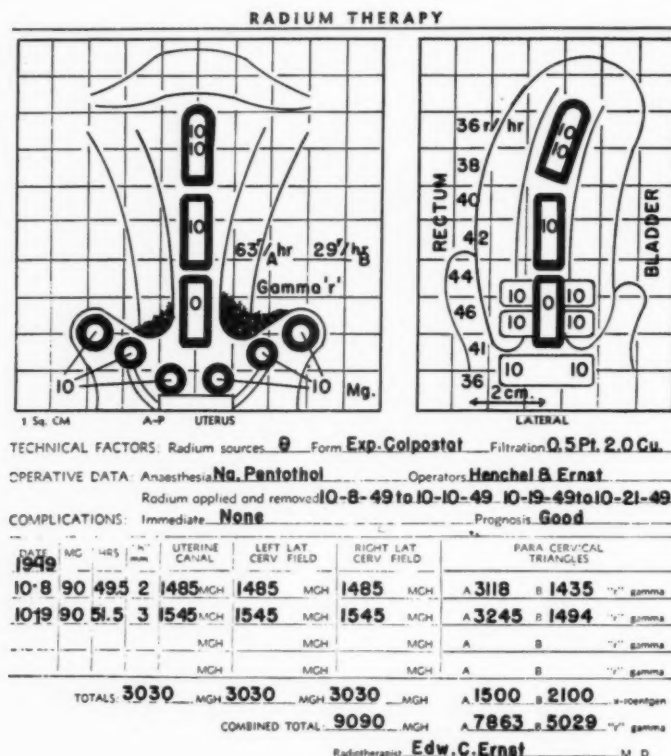


Fig. 3. Proposed radium dosage chart. See text.

IV cases, the single unit type of expanding radium sources and the recently developed vaginal plastic cylinder attachment have eliminated many of the disadvantages inherent in other methods of applying radium, including the partial correction of anatomical and pathological uterine displacements and vaginal deformities. An abdominal "T" binder attached to the outer surface of the vaginal plastic cylinder exerts additional pressure and with precision regulates the position of the applicator within the pelvic corridor between the bladder and rectum.

(A/B ratio of absorption 2.19 per cent), the radium dose can be duplicated by other radiotherapists in the same and other patients.

7. It should be emphasized that the summation of the radiation intensities at points "A" and "B," respectively 2 and 5 cm. lateral to the uterine canal, was not selected because of their supposed anatomical relationship to important lymphatic fields or nodes in the pelvis. Other points could be standardized for the dual purpose of (1) obtaining a gamma-roentgen-per-hour ratio of intensities employed,

for the estimation of the total dose and (2) of ascertaining the coefficient-of-absorption factor, which would percentage-wise interpret and designate the quantity, quality, and distribution of the distant radiation intensities to be anticipated in other, perhaps more important, pelvic fields.

8. When loose or semifixed radium sources are employed the mere calculation of the depth dose in gamma roentgens becomes technically complicated and subject to possible error.

9. Although we have routinely employed much higher intensities in the treatment of carcinoma of the cervix, since 1948, as shown in Figure 3, our clinic records show a substantial reduction in the number of severe initial radiation reactions or delayed injury to the normal structures, even though the measured depth doses in the distant pelvic fields were increased by as much as 50 per cent.

10. The average fractionated radium dose administered in our clinic as part of the five-year radiation research program

ranged between 8,640 and 9,090 mg. hr. It should be emphasized that the clinical application of similar doses of radium may not be warranted as the ideal routine therapeutic procedure in all stages of the disease. This final clinical phase of the dosage problem remains under investigation. For example, in the treatment of the cervical stump or advanced stages of this disease when it is necessary to detach all or part of the uterine stem of the applicator, possibly remove the outer vaginal capsules, or substitute the two larger capsules of the Manchester type, the total radium dose requires considerable modification to meet these individual complications or extensions of the primary lesion.

In this group of cases the plastic cylinder is almost indispensable for maintaining the necessary accurate fixation and full effectiveness of the radium sources within the pelvic corridor between the bladder and rectum.

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SUMARIO

Cilindro Vaginal Plástico

Accesorio del Aplicador Cervico-Uterino Expansivo de Radio

Describe un método de radioterapia para el carcinoma del cuello uterino, en el cual un aplicador cervico-uterino dilatado de radio va complementado por un cilindro vaginal plástico, que no sólo resguarda la mitad externa de la mucosa vaginal, sino que sirve además de fulcro para la regulación eficaz y más inocua de los focos de radio en el corredor mesopelviano entre la vejiga y el recto.

Han observado los AA. que los aparatos expandibles en una sola unidad para focos de radio y el recién elaborado cilindro vaginal accesorio han eliminado muchas de las desventajas inherentes en otros métodos empleados para aplicar dicha substancia. Cuando se utiliza uno de esos aplicadores y se ha uniformizado la dosis de radio en

roentgens gamma por hora, por medio de mediciones comprobadas con un espinterómetro en varios puntos vitales de la pelvis, pueden repetir dicha dosis otros radioterapeutas, obteniéndose así una base para comparación.

A pesar del empleo sistemático de altas intensidades en el tratamiento del cáncer del cuello uterino, los protocolos clínicos de los AA. muestran una reducción substancial en el número de reacciones graves o de lesiones retardadas en los tejidos pelvianos normales, comparado con los resultados observados con focos de radio sueltos o semifijos, aun después de aumentar hasta en 50 por ciento las dosis profundas medidas administradas a los campos pelvianos remotos.

A Roentgenographic Study of Transitory Synovitis of the Hip Joint¹

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TRANSITORY synovitis of the hip joint, called also intermittent hydrarthrosis (2), has been described (1-9) as a disease entity characterized by the following phenomena: (a) symptoms and physical signs of an arthritis of the hip joint; (b) negative x-ray findings; (c) disappearance of all

are to be found within the synovial membrane of the hip joint, and consist in a swelling of the joint capsule following an intra-articular effusion.

As for the nature of the effusion and the etiology of the disease, all authors agree that the cause of the condition is "non-

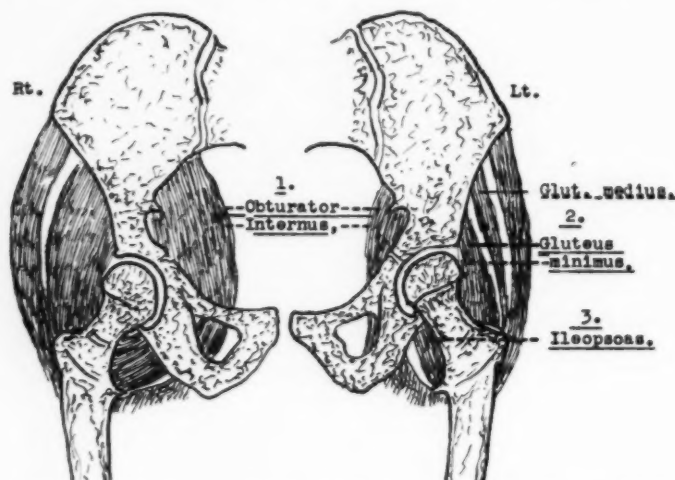


Fig. 1. Muscles related to the hip joint capsule. 1. Obturator internus. 2. Gluteus minimus. 3. Iliopsoas. Edema of the muscles as shown on right indicates synovitis.

symptoms and physical signs within a short period. The disease is one of childhood. The main symptom is most frequently pain of sudden onset in the region of the hip joint, with a limp on the affected side, associated with the usual signs of an infection. A history of previous injury has been obtained in some cases. Limitation of movement, especially of abduction internal rotation, and extension, seems to confirm the clinical diagnosis of arthritis of the hip joint.

The pathological changes of this condition, which is also called "coxitis serosa,"

specific." A low-grade infection in combination with allergy has been cited as a causative factor. Edwards (3) aspirated the involved joint on two occasions. The fluid was xanthochromic. No bacteria were present in stains.

It is universally agreed that the x-ray findings are always *negative*. This, however, concerns only changes in bone. When studying the x-ray appearances of the soft tissues, we were able to find changes which were pathognomonic for a swelling of the synovial membrane, which indicates a synovitis. Our findings are based on the

¹ From the X-ray Department, Municipal Hospital Hadassa, Tel Aviv, Israel. Accepted for publication in May 1952.

fact that a swelling of the synovial membrane is associated with a swelling of the musculature surrounding the joint. Among the muscles which are in direct anatomic relation to the hip joint are three which can easily be recognized in the roentgenogram, the internal obturator, the

shaped outline (Fig. 1, left side). The *gluteus minimus* is the most medial of all the gluteal muscles and can be distinctly differentiated from the *gluteus medius* by a rather broad intermuscular septum, which is more radiolucent than the muscle itself because of its fat content (Fig. 1, left side).



Fig. 2. Case I. Absence of bone changes, with edema of obturator internus, *gluteus minimus*, and *ileopsoas*, indicating synovitis of the hip joint. Muscles on the left normal. (Film retouched)

gluteus minimus, and the *ileopsoas*. Hefke and Turner (7) described the swelling of the obturator internus as an early x-ray sign of infectious arthritis of the hip joint and called it the "obturator sign."

The muscular swelling can be recognized in the roentgenogram as a broadening of the affected muscles and the disappearance of the intermuscular septum, which normally is more radiolucent than the rest of the muscle. When the diseased side is compared with the healthy one, the muscle edema can be recognized either by a circumscribed swelling or by a disappearance of the normal demarcation line between neighboring muscles (Fig. 1, right side).

The normal *obturator* shadow can be recognized at its origin within the obturator foramen, and its course can be followed into the small pelvis by its slightly S-

The *ileopsoas* can be recognized at its insertion into the lesser trochanter, whence it bulges in a slightly curving fashion forward and medially (Fig. 1, left side). The *ileopsoas* can best be demonstrated when the thigh is held in internal rotation and slight abduction. Its medial border must not be mistaken for the *pectineus*, which is inserted into the femur slightly distal to the lesser trochanter.

ILLUSTRATIVE CASES

CASE I: A child of 2 years had suffered from whooping cough two months previously. For three weeks he had not felt well, experiencing pains throughout the body and loss of appetite. He was unable to sit up. Five days before admission to the hospital he complained of pain on moving the right leg. He was admitted with a diagnosis of coxitis dextra. Examination revealed signs of generalized sepsis, pneumonia involving the right lung, pain and

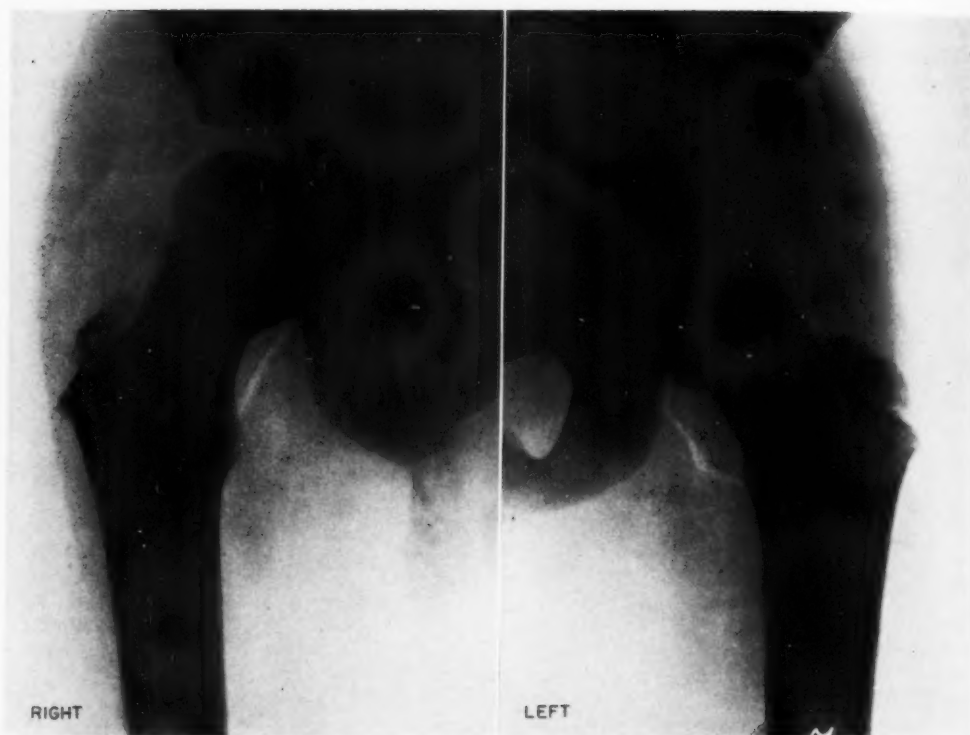


Fig. 3. Case II. No bone changes; edema of left ileopsoas, indicating synovitis. (Film retouched)

limitation of movement in the right hip joint, leukocytosis, and a negative Mantoux test.

Roentgen examination showed no pathological changes in the bones. In the soft tissues there was a considerable broadening of the internal obturator on the right side, as well as haziness of the right gluteus minimus and right ileopsoas; findings in the musculature on the left were normal (Fig. 2).

After four weeks, the temperature returned to normal and the clinical manifestations referable to the hip disappeared. Roentgenologic follow-up at one month and two months showed an entirely normal picture.

This case shows the characteristic clinical course of a transient synovitis, following a low-grade infection, probably in this case a pneumonia. Roentgenograms of the bony parts of the hip joint were negative, but study of the soft tissues revealed definite evidence of edema of those muscles which were in close relation to the hip joint.

CASE II: A child of 7 years was admitted to the hospital with a history of pain of sudden onset in the left hip joint, of two days duration. There had been a rise of temperature to 39° C.; the leukocyte count

was 18,000, with 77 per cent neutrophils; sedimentation rate first hour 31, second hour 45. The tentative diagnoses were osteomyelitis (?), infectious arthritis (?).

The general condition of the child appeared good. There was pain in the region of the left hip and the left knee and hip were held in flexion. Slight swelling was present in the left inguinal region. After three days in the hospital without therapy, the condition improved, and the patient was sitting up and standing in bed. Pain had disappeared, but there was still tenderness on pressure in the region of the left hip and movement, especially rotation and abduction, remained limited. The clinical diagnosis was arthritis of the left hip.

Roentgen examination showed no change in the bone but revealed definite edema of the left ileopsoas muscle, indicative of a synovitis (Fig. 3).

Fourteen days after the onset of the illness all clinical signs of coxitis had disappeared. Roentgen examination after two months showed normal findings in both bone and soft tissues.

This is a typical case of transitory synovitis, with sudden onset and rapid disappearance of all pathological findings. Also characteristic are the swelling of the

ileopsoas as demonstrated roentgenographically, without changes in bone, and finally the normal roentgen picture after two months.

DISCUSSION

It is desired to stress especially the fact that in 9 of 10 cases of transitory synovitis, edema of the ileopsoas, which might be called the "ileopsoas sign," was present. There is no way of differentiating between the soft-tissue changes of transitory synovitis and those of infective arthritis of the hip joint, but in the latter condition there usually appear changes in bone, which can be recognized roentgenographically three to eight weeks after the beginning of the illness. In such cases the synovitis is usually already present at an early stage of the disease and can be demonstrated by means of a roentgenogram showing the muscle edema.

CONCLUSIONS

Up to the present time it has been considered impossible to diagnose transitory synovitis by means of the x-ray examination. The negative findings are, however,

changed into positive ones by taking into consideration the soft tissues. Edema of muscles in the neighborhood of the joint, e.g., the obturator internus, the ileopsoas, and the gluteus minimus, can be recognized in the roentgenogram and represents a sign of synovitis of the hip joint.

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SUMARIO

Estudio Radiográfico de la Sinovitis Transitoria de la Cadera

La sinovitis transitoria de la cadera es un estado observado en la niñez, con síntomas y signos físicos que sugieren artritis, pero que desaparecen completamente dentro de pocotempo. Sehasostenidoquenoproduce alteraciones roentgenológicas, pero esto es cierto únicamente en lo relativo al hueso. Los tejidos blandos revelarán edema de

las membranas sinoviales, que indica edema de la musculatura que rodea la articulación, especialmente del obturador interno, del glúteo menor y del psoasílico. Esto aparece en la radiografía como un ensanchamiento de los músculos y una desaparición del tabique intermuscular, que es más radioluciente que el resto del músculo.

Palm Thorns as a Cause of Joint Effusion in Children¹

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PALM THORNS MAY be the basis of obscure joint effusions in children. Between the years 1946 and 1951, 7 cases of joint effusion due to this cause were seen in the Children's Hospital, Los Angeles. A review of the literature since 1927, however, failed to reveal any similar example.

The offending tree in California is the date palm (*Phoenix dactylifera*, *Phoenix roebelenii*, *Phoenix canariensis*) (Fig. 1). This tree grows throughout the South in areas which do not have frost. Thorns from any of the many varieties of century plant (*Agave americana*) could conceivably produce the same picture, but we have not encountered these in the joints, though they have been seen in the soft tissues.

The palm thorn is particularly treacherous because the tip dries out much faster than the main body of the thorn and is prone to break off. The distal 1.5 to 3.0 cm. becomes sharp, hard, and brittle, showing an abrupt change in color and flexibility. It is easy to see how this needlelike tip could become embedded in soft tissues and be disregarded as a "scratch," or how the main portion of the thorn could be removed and the point left unnoticed and forgotten.

The majority of our patients were approximately six years old at the time of the injury (Table I). The interval from that time to admission to the hospital ranged from seven days to two and a half years. The informants were usually the parents. In some instances, a history of palm thorn injury was elicited only upon the most careful questioning. Even with this, a puncture wound was denied in two cases. In all but one of the remaining five, the thorn was thought to have been removed.

Close co-operation between the radiolo-



Fig. 1. Date palm (*Phoenix*). Arrows point to the thorns, which are found at the base of the limbs.

gist and clinician facilitates the diagnosis of palm thorn injury. The roentgen picture reveals soft-tissue swelling and joint effusion without bone involvement (Fig. 2). In only one of our cases was there no roentgen evidence of disease. The thorns are not radiopaque.

Joint effusion due to palm thorn may be differentiated from tuberculosis and fungus infection by the history of injury, lack of infectious contact, negative tuberculin and coccidioidin skin tests, and the absence of bony involvement as demonstrated on the roentgenogram.

It is obvious that pyogenic arthritis may result from the entry of a palm thorn into a joint, and that both conditions could thus be present simultaneously. One may sus-

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pect an underlying palm thorn in the presence of prolonged joint swelling and a lack of response to antibiotics. In such instances a positive history is most helpful.

Inasmuch as the palm thorn will be found in only a single joint, diseases which affect multiple joints, such as rheumatoid



Fig. 2. Case 6. Joint effusion without bony involvement, of four months duration. Although there was no history of a puncture wound, a palm thorn was removed at surgery.

arthritis, bacteremia, allergic arthritis and Clutton's joints, are easily excluded. Specific clinical findings also accompany these disorders.

The roentgenographic demonstration of bony changes in osteochondritis dissecans and fractures are in themselves diagnostic. Early osteomyelitis may present some



Fig. 3. Case 2. This cystic mass with enclosed palm thorn tip lay outside the knee joint between the deep fascia and joint capsule.

difficulty, but progress films will usually show the characteristic destructive process. Pigmented villonodular synovitis and intermittent hydrarthrosis occur in a much older age group and are not accompanied by local signs of inflammation, although the roentgenographic findings are quite similar.

The pathologic findings are hypertrophic synovitis with granulation tissue and foreign-body giant-cell reaction about the thorn. There may or may not be an associated pyogenic arthritis. The thorn

TABLE I: SUMMARY OF CASES

Case	Age in Years	History of Thorn Injury	Location	Duration	Roentgen Findings		Operative Findings				Course
					Soft Tissue Swelling	Joint Effusion	Thorn	Foreign-Body Reaction	Synovial Thickening	Pyogenic Arthritis	
1	6	+	Knee	9 mo.	+	+	0	+	+	+	No follow-up
2	13	+	Knee	2 1/2 yr.	+	0	+	+	+	0	Asymptomatic
3	11	+	Knee	10 days	0	0	+	0	0	0	Asymptomatic
4	6	+	Elbow	14 days	+	+	+	+	+	+	Osteomyelitis developed one year later
5	5	0	Knee	7 days*	+	0	+	0	0	0	Asymptomatic
6	6	0	Knee	4 mo.*	+	+	+	+	+	+	Limited motion after five months
7	6	+	Knee	21 days	+	+	+	+	+	0	Asymptomatic

* Duration of symptoms.

may lie free in the joint cavity or it may be imbedded in the infrapatellar fat pad. In one of our cases it was enclosed in a cyst-like structure filled with fluid and surrounded by granulation tissue (Fig. 3).

The aim of treatment is to control any secondary infection with antibiotics prior to surgical removal of the thorn and surrounding granulation tissue. The length of sojourn of the thorn in the joint had no effect on the final outcome in our cases. The postoperative results were generally good, although one patient has a slight limitation of motion. In another patient (Case 4) osteomyelitis developed in the same joint one year later, probably related to the original palm thorn injury. This patient was treated by sequestrectomy and made an uneventful recovery.

DISCUSSION

A palm thorn may affect a joint in three ways, of which the mechanical factor of a foreign body is the most important. In the second place, the thorns are always dirty and introduce pyogenic infection. There is also the ever present danger of a tetanus infection. Finally, the thorns apparently contain an irritant which in a few individuals causes an immediate massive swelling. This may be quite painful and has been compared by some patients to a bee sting.

The knee is most frequently involved because of its accessibility to injury. The usual history is that the child was either climbing a palm tree or fell on some dead palm limbs with the result that a thorn punctured the knee joint or infrapatellar fat pad. An attempt at removal is then made by the parent but, as pointed out above, the tip of the thorn is prone to break off and only a portion is actually extracted. Several

days to two weeks later there is inflammation about the joint and possibly a joint effusion. If the patient is treated with antibiotics, the swelling and inflammation will usually subside, only to be followed by exacerbations and a chronically swollen, tender, and painful joint.

The patient may be referred to the radiology department for consultation. With an adequate history and the roentgenographic finding of soft-tissue swelling and joint effusion without bone involvement, an underlying palm thorn should be suspected. We feel that the mechanical effect of the thorn as a foreign body is not the whole reason for the chronic arthropathy. Some chemical factor would appear to be involved, as evidenced by the allergic reaction of certain individuals, which serves to enhance and prolong the disability of the involved joint.

Surgical removal of the thorn offers good results. The knees of our patients are explored through anteromedial incisions. If the thorn is not found, the patient is turned over on the table and a posterior incision is made. The thorn and surrounding granulation tissue are removed and the wound is closed without drains.

SUMMARY

1. A palm thorn in or about a joint may be the cause of obscure chronic joint effusion without bony changes in children.
2. A history of injury in some instances may be obtained only by diligent questioning.
3. Good results follow surgical removal of the thorn and surrounding granulation tissue.

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SUMARIO

Las Espinas en las Manos como Causa de Derrame Articular en los Niños

Las espinas de la palmera datilera (Fénix) resultaron ser la causa de 7 casos de obscuro derrame articular en niños, sin

invasión ósea, observados en el Sur de California entre 1946 y 1951.

Un interrogatorio persistente pondrá de

manifiesto habitualmente una historia de herida penetrante por la espina, más frecuentemente en la rodilla. En la mayor parte de los casos, se cree que se ha extraído la espina, cuando en realidad se ha roto al tratar de sacarla, dejando adentro la aguda y quebradiza punta. Sobreviene inflamación y el examen radiográfico

muestra edema de los tejidos blandos y derrame articular. La espina misma no es radiopaca. La extracción quirúrgica de la espina va seguida de buenos resultados con tejido de granulación.

Al parecer, las espinas contienen un factor irritante que puede desempeñar un papel en la producción de síntomas.



EDITORIAL

The Acute Radiation Syndrome

The radiologist has had unique preparation for appreciation of the effects of acute radiation on the human organism. In meeting the challenge of increasing civilian and military uses of atomic energy, as well as the possibilities of atomic warfare, he must be concerned with the details of the acute radiation syndrome and new information concerning it. Until recently, the major sources from which such knowledge was derived were small animal experiments, clinical radiological experience, and reports of the effects of the Hiroshima and Nagasaki explosions. Estimations of the response of human beings to whole-body radiation as obtained by extrapolation from clinical experience have proved to be entirely inadequate. The very large volume of radiobiological data from small animal experiments is not completely satisfactory as a basis for predicting human reactions. The Hiroshima and Nagasaki observations are complicated by incompleteness of data on radiation intensities, lack of objective clinical studies in the early stages, and the presence of superimposed thermal and mechanical injuries.

Two recent publications have such particular interest with respect to acute radiation reactions that it seems appropriate to direct specific attention to them. The acute radiation syndrome is described in papers of Hempelmann (1) and Hempelmann, Lisco, and Hoffman (2), based on nine cases of accidental exposure at the Los Alamos Scientific Laboratory. The second of these papers is a comprehensive monograph published as a separate part of the February 1952 issue of the *Annals of Internal Medicine*. In it, the acute radiation syndrome is defined as "the group of signs and symptoms which characterize the ill-

ness produced by exposure to ionizing radiations of the entire body or a large part of the body." It is to the credit of the health and safety operations at the Los Alamos Laboratory that only ten such unfortunate accidents occurred. It is fortunate that these cases were so carefully studied. The radiations consisted of moderately fast neutrons and hard gamma rays from temporarily uncontrolled fission reactions. They did not produce uniform radiation patterns throughout the bodies of the exposed persons, but the patterns are carefully analyzed and the physical corrections seem adequate for comparison with homogeneous whole-body exposures. The individual cases are presented with clinical completeness, exhaustive documentation and analysis of laboratory data, and interpretation with regard to the biological basis for the clinical responses. In the ten cases from which the nine reported are drawn, two individuals died as a result of the acute radiation injury; one other showed a typical acute radiation syndrome and recovered. Four others, who received lesser exposures, showed hematological reactions. These cases are unique, they are presented with great care, and they merit the close study of all radiologists.

With such restricted human material which can be carefully analyzed and with the urgent need for more observations referable to human beings, experiments with large animals assume particular importance. Elsewhere (3) in this issue of *RADIOLOGY* appears a report on whole-body radiation of the burro. These experiments are not with acute exposures of the type discussed above, but they are done with the attention to detail which will add significantly to the scope of information

desired. There are few other large animal studies in the unrestricted literature, but it would seem desirable to encourage declassification of all possible material. More experimentation with large animals should be continued in spite of the relatively greater cost and technical difficulties.

Our understanding of radiobiological phenomena is fragmentary at fundamental levels as well as at the human clinical level. The fundamental approach is most likely to furnish insight into mechanisms which may lead to protective measures against radiation damage, but the necessity for an informed and prepared body of radiologists

cannot wait until the field is completely explored. It is to be hoped that the radiologist will find stimulating interest in these reports and that he will apply himself to understanding all that is known at the present time.

RICHARD H. CHAMBERLAIN M.D.

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ANNOUNCEMENTS AND BOOK REVIEWS

PENNSYLVANIA RADIOLOGICAL SOCIETY

The 38th Annual Meeting of the Pennsylvania Radiological Society will be held on May 22 and 23, 1953, at the Necho Allen Hospital, in Pottsville.

The officers of the Society for 1953 are: President, William V. Dzurek, M.D., Pottsville; President-Elect, Joseph T. Danzer, M.D., Oil City; First Vice-President, Lewis E. Etter, M.D., Pittsburgh; Secretary-Treasurer, James M. Converse, M.D., Williamsport; Editor of the Journal of the Pennsylvania Radiological Society, Carl B. Lechner, M.D., Erie.

CONTINUATION COURSE IN RADIOLOGY FOR GENERAL PHYSICIANS

The University of Minnesota will present a continuation course in Radiology for General Physicians next May 21 to 23 under the direction of Dr. Leo G. Rigler, Professor and Head, Department of Radiology. Registrants for the course will spend most of their time in the University Hospital Department of Radiology reading films and carrying out procedures in association with members of the faculty of that department. A minimum of didactic material will be presented. Because of the nature of this course, registration will be strictly limited. Early application is therefore suggested. Accommodations will be available in the Center for Continuation Study as usual.

SEVENTH INTERNATIONAL CONGRESS OF RADIOLOGY

Word has been received from Dr. Flemming Nørsgaard, Secretary-General of the Seventh International Congress of Radiology, to be held in Copenhagen, Denmark, July 19-25, 1953, that owing to an unexpectedly large number of applications for membership, further enrollments are being refused. The following letter is being sent to those who now apply for membership.

DEAR COLLEAGUE:

We have received your request for the Preliminary Program and accordingly enclose a copy herewith. We must point out, however, that we very much regret that since the 1st January, 1953, which was the closing date for enrollments at normal fee, we have been unable to accept further applications for membership of the Congress. Even prior to that date the number of enrollments was far greater than anticipated up to the time of the Congress itself, and it is impossible to procure hotel accommodations for any further members.

Those who have already enrolled can be accommodated, but we have been unfortunate in that two

large hotels due for completion by the time of the Congress will not now be ready owing to the fact that priority has been given to military buildings in accordance with the Atlantic Pact. This has deprived us of 600 beds on which we had counted and which would undoubtedly have enabled us to accept enrollments up to the time of the Congress.

If by any chance you have friends here with whom you could stay, the position would be somewhat different and we should be glad to enroll you as a Congress member. We must warn you, however, *on no account* to come to Copenhagen without having made previous arrangements for accommodation, as it will be quite impossible for you to find rooms when you arrive.

If you can find accommodation and would like to enroll, we should be glad to hear from you as soon as possible. As stated in the Preliminary Program applications for day membership only will be accepted after 1st June.

If you decide not to attend the Congress we can offer you the Book of Abstracts for a cost of 12 Danish crowns. We are also arranging for the publication of the full texts of the symposia papers in a special volume of *Acta Radiologica* at a price of approximately 40 Danish crowns. If you are interested in purchasing these books would you kindly send us your order before 1st May.

Yours sincerely,

FLEMMING NØRGAARD
Secretary-General

P. FLEMMING MØLLER
President

Letters to the Editor

MAGNIFICATION OF RADIOGRAPHIC IMAGES

To the Editor of Radiology

DEAR SIR:

In a footnote to their article (*Radiology* 59: 866, 1952) Gilardoni and Schwarz stated:

"Fletcher and Rowley have published an eight fold enlargement of a radiographic of an ankle as their greatest enlargement. This approaches the limit of permissible geometrical unsharpness for so large an anatomical part. . . . From its reproduction it is impossible to judge whether its sharpness is adequate."

This cannot be allowed to pass without comment, in that no such radiograph was published by us. We have published a four fold enlargement of part of an elbow joint and several eight fold enlargements of small joints of the extremities. In each case the degree of enlargement is well below the theoretical maximum given by Gilardoni and Schwarz. Further-

more whereas these authors accept up to 0.3 mm. of geometrical blurring, our limit was set at 0.2 mm. In view of these comments we wish to refute the criticisms implied in the footnote to which we refer.

In our paper the technical problems of film grain, development, contrast, double emulsion, and blurring were considered in detail. Gilardoni and Schwarz, in their paper, have on the whole reached similar conclusions to those arrived at by us. We feel, however, that the question of development has been dismissed too lightly by these authors. Despite the inevitable loss of contrast resulting from the use of fine grain developers or reduced development time, we were able to show that a satisfactory compromise was possible using industrial film in this way rather than with routine development.

The use of fine grain developer is time consuming and more suited to research than routine procedures. In the former capacity it was used to advantage by us in our work on the changes of rheumatoid arthritis in the extremities (Fletcher, D. E., and Rowley, K. A.: *Brit. J. Radiol.* **25**: 282, 1952). Even in everyday work, however, the use of industrial film with half the normal development in x-ray developer is valuable in providing detail not demonstrated by ordinary techniques.

Yours faithfully,
KENNETH A. ROWLEY
DENIS E. FLETCHER
The Manchester Royal
Infirmary
Manchester, England

To the Editor of Radiology

DEAR DR. DOUB:

My apologies to Drs. Rowley and Fletcher for misinterpreting one of their published radiographs. No implied criticism was intended by Dr. Gilardoni or myself. On the contrary, we specifically stated that from the reproduction it was impossible to judge of its sharpness. We are certain that all their enlargements are adequate in their original form.

There is more to say, however, about the problem of developers. In the absence of Dr. Gilardoni, I speak on this subject for myself only and welcome the opportunity to relate my more recent experiences and conclusions.

It is true that there is a gain in definition when one uses fine grain developer instead of x-ray developer if only the magnification range between $\times 2$ and $\times 10$ is considered. In this range, neither photographic definition nor lack of contrast is a major problem, single-coated Eastman periapical regular film developed in x-ray developer for about 60 per cent of the normal time performing adequately.

We were interested, however, in driving the magnification of roentgenograms (obtained on living human beings) beyond this limit. We have indeed obtained magnifications of $\times 20$ and $\times 50$ (photomicrographed radiographs), but their quality was

unsatisfactory. It turned out that graininess was less of a stumbling block in this range of magnification than lack of contrast and loss of film speed. Both these deficiencies were minimized—to our surprise—by using x-ray developer and Kodalith film, a film which normally possesses extremely fine grain. The x-ray developer reduced the resolving power of this film considerably (and had the tendency to fog it without special care to the contrary), but it produced much better contrast and a speed much higher than listed in our published table. In short, by using the next slower film listed in our table and using extreme development we obtained an advantage which cannot be gained by any other means.

Very truly yours,
GERHART S. SCHWARZ, M.D.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

AN ATLAS OF SKULL ROENTGENOGRAMS. By BERNARD S. EPSTEIN, M.D., Associate Radiologist, The Jewish Hospital of Brooklyn, Brooklyn, N. Y., and LEO M. DAVIDOFF, M.D., Neurosurgeon to the Mount Sinai Hospital, New York City, and Director of Neurological Surgery, the Beth Israel Hospital, New York City. A volume of 416 pages, with 603 illustrations. Published by Lea & Febiger, Philadelphia, 1953. Price \$15.00.

FUNDAMENTALS OF CLINICAL CANCER, WITH EMPHASIS ON EARLY DIAGNOSIS AND TREATMENT. By LEONARD B. GOLDMAN, M.D., Clinical Professor of Radiotherapy, New York Medical College, Flower and Fifth Avenue Hospitals; Chairman, Tumor Conference, and Director, Radiation Therapy Department, Queens General Hospital; Consultant Radiation Therapist, Flushing, Rockaway Beach and Triboro Hospitals, New York City. A volume of 312 pages, with 221 illustrations. Published by Grune & Stratton, Inc., 381 Fourth Ave., New York, N. Y., 1953. Price \$8.75.

GASTRIC CANCER. By ALFRED H. IASON, M.D., Attending Surgeon, A. J. J. Hospital; Director of Surgery, Brooklyn Hospital for the Aged; Surgeon, Manhattan General Hospital; Instructor in Anatomy, New York Medical College and Flower Hospital. Illustrations by Alfred Feinberg, Instructor of Medical Illustration, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York City. A volume of 316 pages, with 100 illustrations. Published by Grune & Stratton, Inc., 381 Fourth Ave., New York, N. Y., 1953. Price \$7.50.

FUNDAMENTALS OF CLINICAL ORTHOPEDICS. By PETER A. CASAGRANDE, M.D., Orthopedic Department of Buffalo General Hospital, Buffalo Children's Hospital, and the University of Buffalo Medical School; Attending Orthopedist at the Chronic Disease Research Institute of the University of Buffalo, and the Veterans Administration Hospital, Buffalo, N. Y., and HAROLD M. FROST, JR., M.D., Orthopedic Department of Buffalo General Hospital and the University of Buffalo Medical School, Buffalo, N. Y. Forewords by JOSEPH S. BARR, M.D., and FRANK N. POTTS, M.D. A volume of 582 pages, with 390 illustrations. Published by Grune & Stratton, Inc., 381 Fourth Ave., New York, N. Y., 1953. Price \$18.50.

A ROENTGENOLOGIC STUDY OF THE CORONARY ARTERIES IN THE LIVING. Acta Radiologica Supplement 97. By LUCIO DIGUGLIEMMO and MARIANO GUTTADAURO. From the First Roentgen Department (Director: Docent Gunnar Jönsson), Södersjukhuset, Stockholm, Sweden. A monograph of 82 pages, with 49 figures. Published by Acta Radiologica, Stockholm 2, Sweden, 1952. Price Sw. Kr. 20.

RADIOTHERAPY IN CANCER OF THE BREAST. WITH PARTICULAR REFERENCE TO THE VALUE OF PRE-OPERATIVE IRRADIATION AS SUPPLEMENT TO RADICAL MASTECTOMY. ANALYSIS OF 1418 NEW CASES. Acta Radiologica Supplement 98. By SIGVARD KAAE. A monograph of 190 pages, with 12 figures and 73 tables. Published by Danish Science Press, Ltd., Copenhagen, 1952. Price Sw. Kr. 20.

BIOLOGICAL HAZARDS OF ATOMIC ENERGY, BEING THE PAPERS READ AT THE CONFERENCE CONVENED BY THE INSTITUTE OF BIOLOGY AND THE ATOMIC SCIENTISTS' ASSOCIATION, OCTOBER 1950. Edited by A. HADDOW. A volume of 236 pages, with numerous illustrations. Published by the Oxford University Press, London, 1952. Price \$8.00.

THIRTEENTH SEMIANNUAL REPORT OF THE ATOMIC ENERGY COMMISSION, JANUARY 1953. 210 pages. Published by the United States Government Printing Office, Washington, D. C.

OSTEOSKLEROSE UND KNOCHENMARKFIBROSE. By RUDOLF STODTMEISTER, Dr. med. Dr. phil., apl. Professor für innere Medizin an der Universität Heidelberg, Chefarzt der Inneren Abteilung des Städtischen Krankenhauses Pforzheim, and STEFAN SANDKÜHLER, Dr. med., Assistent der Rudolf-Krehl-Klinik (Medizin. Univ.-Klinik), Heidelberg, unter röntgenologischer MITARBEITUNG VON ALBERT LAUR, Dr. med. Assistent der Röntgenabteilung der Lufolf-Krehl-Klinik (Medizin. Univ.-

Klinik) Heidelberg. A volume of 136 pages, with 29 figures. Published by Georg Thieme, Stuttgart, 1953. Distributors for U. S. A., Grune & Stratton, Inc., 381 Fourth Ave., New York, N. Y. Price DM 28.50.

Book Reviews

PNEUMOPERITÔNIO DIAGNÓSTICO. By FRANCISCO CALVALCANTI DA SILVA TELLES. A monograph of 198 pages, with 76 plates. São Paulo, 1951.

The author reviews his experience with pneumoperitoneum (based on the study of more than a hundred cases) as a procedure in differential diagnosis. He states that most accidents are due to technical mistakes and that if carbon dioxide or nitrous oxide are used, there is slight risk of embolism. There is no interference with normal functions, provided that the quantity of gas introduced was not excessive.

The case histories and roentgenograms of 30 patients are presented to emphasize the value of pneumoperitoneum in clarifying the diagnosis in obscure cases. The method can often be combined advantageously with other diagnostic techniques even though it is true that many experienced roentgenologists have never had an occasion to use it.

ROENTGEN-DIAGNOSTICS. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, and E. UEHLINGER. First American Edition (Based on the Fifth German Edition). English translation arranged and edited by JAMES T. CASE, M.D., D.M.R.E. Professor of Radiology Emeritus, Northwestern University Medical School, Chicago. Volume II. Skeleton (Part 2), 1,190 pages, with 1,491 illustrations. Published by Grune & Stratton, New York, N. Y., 1952. Price \$45.00.

Volume II of Roentgen Diagnostics, the American edition of the highly regarded *Lehrbuch der Röntgendiagnostik*, is now available. As with the first volume (reviewed in *RADIOLOGY* 58: 430, 1952) the translation was arranged by Dr. James T. Case and his collaborators and is of the same high quality.

Volume II completes the discussion of the skeletal system, begun in Volume I. There is an excellent section on bone tumors, both primary and malignant. Succeeding chapters are devoted to skeletal malformations, the relation of vitamins to bone diseases, disturbances of growth and maturity, and the relation of hormones to bone diseases.

In the section on joint injuries the authors cover traumatic bone affections; infectious joint diseases, arthritides; degenerative joint diseases, arthroses; hereditary joint diseases; and neoplastic joint diseases. Many of the basic factors underlying the arthritides are discussed.

The roentgen diagnosis of the vertebral column occupies another section, with a chapter on myelography. Most of the diseases and anomalies common to the spine are taken up.

Two hundred and fifty pages are given over to a consideration of the roentgenologic diagnosis of the skull and its contents, including the teeth and jaws, with an extensive discussion of air studies and angiography.

The remaining chapters are devoted to the muscles and other soft tissues, foreign bodies and

their localization, and the differential diagnosis of the skeletal diseases.

The volume is attractively bound and contains many well chosen illustrations. A comprehensive bibliography is given at the end of each section. An index, covering Volumes I and II, is a welcome addition. Dr. Case and his associates are to be congratulated on the excellence of their translation and the arrangement of the material. Radiologists are looking forward to the subsequent volumes on the other bodily systems.



RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 15 East Monroe, Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Calvin L. Stewart, M.D., 2330 First Ave., San Diego.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Joseph F. Linsman, M.D., 436 N. Roxbury Dr., Beverly Hills. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY. *Secretary*, Richard C. Ripple, M.D., 1215 28th St., Sacramento. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Ford Shepherd, M.D., 526 Soquel Ave., Santa Cruz. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wm. S. Curtis, M.D., Boulder Medical Center, Boulder. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, U. V. Wilcox, M.D., 915 19th St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. Judson Graves, M.D., 2002 Park St., Jacksonville. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, E. Hampton Bryson, M.D., 273 Alhambra Circle, Coral Gables. Meets monthly, third Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 478 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert M. Tankesley, M.D., 218 Doctors Bldg., Atlanta. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital. Augusta.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Col. Alexander O. Haff, Tripler Army Hospital, Honolulu. Meets monthly on the third Friday, at Tripler Army Hospital.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 23 East Ohio St., Indianapolis. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, James McMillen, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and holds a scientific session in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Willis L. Beller, M.D., 700 Kansas Ave., Topeka. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Hugh Allan Smith, M.D., Eastern Maine General Hospital, Bangor. Meets three times a year—Spring, Summer, and Fall.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, H. Leonard Warren, M.D., 2337 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John

R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Sidney Rubin, M.D., 410 Professional Bldg., Kansas City, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd., St. Louis 3. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 8:45 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Joseph J. La Vine, M.D., 259 North Grand Avenue, Baldwin, N.Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Harold W. Jacox, M.D., 622 W. 168th St., New York 32.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY.

Secretary-Treasurer, John F. Roach, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

ROCHESTER ROENTGEN-RAY SOCIETY.

Secretary-Treasurer, A. Gordon Ide, M.D., 277 Alexander St. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY.

Secretary, Clifford C. Baker, M.D., Harwood Bldg., Scarsdale. Meets third Tuesday of January and October and at other times as announced.

North Carolina**RADIOLOGICAL SOCIETY OF NORTH CAROLINA.**

Secretary, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota**NORTH DAKOTA RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association and in the Fall or Winter on call.

Ohio**OHIO STATE RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, Willis S. Peck, M.D., 1838 Parkwood Ave., Toledo 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY.

Secretary, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY.

Secretary-Treasurer, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY.

Secretary-Treasurer, Harry K. Hines, M.D., 2508 Auburn Ave., Cincinnati 19. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY.

Secretary, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma**OKLAHOMA STATE RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon**OREGON RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, J. Richard Raines, M.D., Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club.

Pacific Northwest**PACIFIC NORTHWEST RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania**PENNSYLVANIA RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY.

Secretary, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY.

Secretary-Treasurer, Donald H. Rice, M.D., West Penn Hospital, Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States**ROCKY MOUNTAIN RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, Maurice D. Frazer, M.D., 1037 Stuart Bldg., Lincoln, Nebr.

South Carolina**SOUTH CAROLINA RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, Henry E. Plenge, M.D., Spartanburg General Hospital, Spartanburg. Meets with State Medical Association in May.

South Dakota**RADIOLOGICAL SOCIETY OF SOUTH DAKOTA.**

Secretary-Treasurer, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee**MEMPHIS ROENTGEN CLUB.**

Secretary, Harvey Thompson, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY.

Secretary-Treasurer, J. Marsh Frère, M.D., Newell Hospital, Chattanooga 2. Meets annually with State Medical Society in April.

Texas**DALLAS-FORT WORTH ROENTGEN STUDY CLUB.**

Secretary, Claude Williams, M.D., Fort Worth. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY.

Secretary, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY.

Secretary, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Building, San Antonio 5, Texas. Meets at Brook Army Medical Center, the first Monday of each month.

TEXAS RADIOLOGICAL SOCIETY.

Secretary-Treasurer, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 29-30, 1954, in Dallas.

Utah**UTAH STATE RADIOLOGICAL SOCIETY.**

Secretary-Treasurer, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John N. Burkey, M.D., 555 Medical-Dental Bldg., Seattle. Meets fourth Monday, September through May, at College Club, Seattle.

Wisconsin

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ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

- HORRAX, GILBERT, AND STRAIN, RICHARD E. Subjective and Objective Criteria in the Diagnosis of Meningiomas of the Brain, with Remarks as to Mortality and Useful Survival..... 609
- YOUNGHUSBAND, OMAR Z., ET AL. Chromophobe Pituitary Tumors. I. Diagnosis..... 609
- ZIMMER, JOHANNES. Planigraphy of the Temporal Bone..... 610
- ROSENDAL, TH., AND EWERTSEN, H. Roentgen Examination of the Temporal Bone for Cholesteatoma..... 610
- THOMSEN, GREGERS, AND GUTTADAURO, MARIANO. Cleidocranial Dystosis Associated with Osteosclerosis and Bone Fragility..... 610
- MACMILLAN, ALEXANDER S., AND KELEMEN, GEORGE. Radiography of the Supraglottic Speech Organs. A Survey..... 610

The Chest

- MELOT, ET AL. Actual Applications of Angiopneumography..... 611
- NORDENSTRÖM, BJÖRN, E. W. A New Method of Bronchography with Water Soluble Contrast..... 611
- GARLAND, L. H., AND COCHRANE, A. L. Results of an International Test in Chest Roentgenogram Interpretation..... 611
- ROTHSTEIN, EMIL, AND GERSON, CHARLES E. Pulmonary Tuberculosis Following Resection for Nontuberculous Disease..... 611
- MARTIN, JAMES F., AND FRIEDEL, HYMER L. The Roentgen Findings in Atelectasis of the New-born, with Special Reference to Changes in the Cardiac Silhouette..... 612
- COOKE, FRANCIS N., AND BLADES, BRIAN. Cystic Disease of the Lungs..... 612
- TÖPPNER, R. Roentgenography of the Soot Lung..... 613
- HAYMAN, LOUIS D., AND HUNT, ROBERT E. Pulmonary Fibrosis in Generalized Scleroderma. Report of a Case and Review of the Literature..... 613
- CHAKRAVARTI, AMAL. Pulmonary Amoebiasis.... 614
- FITCH, EDWARD A., ET AL. Intrathoracic Goiter... 614
- ELKIN, MILTON, ET AL. Systolic Expansion of the Left Auricle in Mitral Regurgitation..... 614
- JÖNSSON, GUNNAR, AND SALTZMAN, GEORG-FREDRIK. Infundibulum of the Patent Ductus Arteriosus Studied by Thoracic Aortography..... 614
- SHAPIRO, DAVID. The Leriche Syndrome (Thrombotic Obliteration of the Aortic Bifurcation)..... 615

- BRANDT, J. L., ET AL. Slit-Kymographic Evidence that Nitroglycerine Decreases Heart Volume and Stroke Volume While Increasing the Amplitude of Ballistocardiographic Waves..... 615

The Digestive System

- PAPE, R., AND HACKENSELLNER, H. A. Roentgenologic Appearance of Neurogenic Tumors of the Digestive Tract..... 615
- FRIEDMAN, ROBERT L., AND WASCH, MILTON G. Carcinoma of the Cardia of the Stomach as Detected by Laminagraphy..... 616
- BADNER, DONALD H., AND CAPLAN, MAX. Gastric Lipoma..... 616
- RUZIC, JAY P., ET AL. Gastric Lesion of Loeffler's Syndrome. Report of a Case with Inflammatory Lesion Simulating Carcinoma..... 616
- GAGLIARDI, RAYMOND A. "Upside Down Stomach": Rare Form of Diaphragmatic Hernia. Report of a Case..... 616
- WAGNER, MARVIN. Clinical Significance of Heterotopic Pancreas in Wall of Stomach. Report of a Case and Review of the Literature..... 616
- PALUMBO, LOUIS T., ET AL. Partial Gastrectomy With and Without Vagus Resection in Treatment of Duodenal Ulcer: Comparative Analysis of Results of Gastrectomy Alone and Combined with Infradiaphragmatic Vagus Resection..... 617
- BULLOCK, W. K., AND SNYDER, EDWARD N., JR. Benign Giant Duodenal Ulcer..... 617
- ABBOT, FRANK K., ET AL. Relation of Sustained Contraction of the Duodenum to Nausea and Vomiting..... 617
- MILCH, ELMER, ET AL. Recurrent Gallstone Small Bowel Obstruction..... 617
- STEVENSON, CLYDE A., AND SOMMER, ARNO W. Chronic Perforating Carcinoma of Colon.... 618
- BERANBAUM, SAMUEL L., AND WALDRON, ROBERT J. Chronic Ulcerative Colitis. Case Report in a New-born Infant..... 618
- DEAN, GILBERT O., AND MURRY, J. WARREN. Volvulus of the Sigmoid Colon..... 618
- KOSS, LEOPOLD G. Abdominal Gas Cysts (Pneumatosis Cystoides Intestinorum Hominis). An Analysis with a Report of a Case and a Critical Review of the Literature..... 619
- LIVINGSTON, HAROLD J., AND LIVINGSTON, SAUL F. "Re-Formed Gall Bladder" with Stones Following Cholecystectomy Seventeen Years Ago..... 619
- RAVITCH, MARK M., AND HANDELSMAN, JACOB C. Defects in Right Diaphragm of Infants and Children with Herniation of Liver..... 619
- HICKEN, N. FREDERICK, AND McALLISTER, A. JAMES. Is the Reflux of Bile into the Pan-

- creatic Ducts a Normal or Abnormal Physiologic Process?..... 619
- MAXWELL, R. W., ET AL. Vitamin Studies in Middle-Aged and Old Individuals. VII. Roentgenological Studies of the Gastrointestinal Tract in Patients with Hypovitaminemia B₁..... 620

The Musculoskeletal System

- FLETCHER, D. E., AND ROWLEY, K. A. The Radiological Features of Rheumatoid Arthritis..... 615
- COWAN, IRVING I., AND STONE, JOSEPH R. Painful Periarticular Calcifications at the Wrist and Elbow: Diagnosis and Treatment..... 615
- NOVOTNY, HANS. Osteochondrosis Dissecans in Two Brothers. The Pre- and Developed State..... 616
- GÜNSEL, E. Spondylosis Chondromalacia..... 616
- UDE, WALTER H. Osteitis Condensans Illii. The Relationship to Juvenile Epiphysitis..... 616
- POOL, CHALMERS S., AND MESCHAN, ISADORE. Fractures of the Spine During Insulin Shock Therapy..... 616
- EPPRIGHT, RICHARD H., AND BOYLSTON, BEDFORD F. Multiple Slipped Femoral Epiphyses. Case Report..... 616
- REYERSBACH, GERTRUD C., ET AL. Vitamin A Intoxication. Report of a Case..... 616

The Blood Vessels

- MILLER, J. E. Aneurysm of the Ascending Aorta..... 617
- MACEWEN, J. Abdominal Aortic Aneurysm..... 617

Obstetrics and Gynecology

- BELL, J. SHERIDAN, AND RAWLINGS, ARTHUR J. Roentgen Fetal Cephalometry..... 617
- QVIST, CARL F. Soft-Tissue Radiography of the Placenta..... 617
- SUTTON, DAVID. Placental and Pelvic Angiography by Retrograde Percutaneous Injection of the Femoral Artery: A Preliminary Report..... 617
- 618

The Genitourinary System

- ORKIN, LAZARUS A. Bedside Urological X-Ray Examination of the Severely Injured Patient..... 618
- 618
- MCLAUGHLIN, WILLIAM L., AND BOWLER, JOHN P. Excretory Urography in the Diagnosis of Ureteropelvic Obstruction..... 619
- REDISH, MILTON H. Ureteral Complications and Alterations of Ureteral Tonus in Regional Ileitis..... 619
- NÖRDENSTROM, BJÖRN E. W. A Method of Topographic Urethrocytography in Women..... 619
- MILNER, W. A., ET AL. Cystitis Emphysematosa. Case Report with Clinical Diagnosis and Review of the Literature..... 619
- BRODNY, M. LEOPOLD, AND ROBINS, SAMUEL A. The Sequelae of Prostatic Surgery..... 619

The Adrenals

- CAHILL, GEORGE F. Pheochromocytoma: Diagnosis and Treatment..... 625

Technic; Contrast Media

- FAGERBERG, STIG. Pneumoretroperitoneum. Technique and Results..... 620
- VON MOOS, F. Tomography in Conjunction with Pneumoretroperitoneum..... 625
- CARTER, R. FRANKLIN, AND SAYPOL, GEORGE M. Transabdominal Cholangiography..... 626
- LOWMAN, ROBERT M., ET AL. A Preliminary Evaluation of a New Cholecystographic Medium "Telepaque"..... 626
- CAMERMAN, J. Hepatosplenography: Results Obtained with a New Contrast Medium..... 626
- LÉGER, JEAN-LOUIS. Preliminary Report on the Use of a New Contrast Medium: Angiopac... 626
- ROSSI AND BARONCHELLI. Preliminary Experience in Hepatolienography with Ethyl Iodostearate (Angiopac)..... 627
- SMITH, PARKE G., ET AL. The Technique of Translumbar Arteriography..... 627
- MELICK, W. F., ET AL. The Experimental and Clinical Investigation of Various Media Used in Translumbar Aortography..... 627
- KOBAK, MATHEW W., ET AL. Venography in Chronic Venous Insufficiency of the Lower Extremities..... 627
- TROUT, E. DALE, ET AL. Use of Filters to Control Radiation Exposure to the Patient in Diagnostic Roentgenology..... 627
- FOSSATI, FRANCO. Photoroentgenography at High Voltage (100-180 kv.) and Low Current (2-8 ma.)..... 628

RADIOTHERAPY

- LAWRENCE, KNOWLES B., AND LENSON, NORMAN. Reticulum Cell Sarcoma. Report of a Thirteen-Year Survival Following One Thousand Roentgens of X-Ray Therapy..... 628
- ANDERSON, O. WILLIAM. Neuroblastoma with Skeletal Metastases and Apparent Recovery.. 628
- COUTTS, WALDEMAR E., AND SILVA-INZUNZA, EDNA. Contribution to the Immediate Dark-Field Cytodiagnosis of Cancer Cells..... 628
- NIELSEN, ANNA MARGRETHE. Cytological Changes in Vaginal Smears in Radium and Roentgen Irradiation of Uterine Carcinoma and Their Prognostic Significance. Preliminary Report..... 628
- PAYNE, FRANKLIN L. The Role of Radiation and of Surgery in the Management of Uterine Carcinoma..... 629
- TAYLOR, HOWARD C., JR. Controversial Points in the Treatment of Carcinoma of the Cervix... 629
- CURRIE, DAVID W. The Association of Radium and Surgery in the Treatment of Carcinoma of the Cervix..... 630
- HUNDLEY, J. MASON, JR., ET AL. Treatment of Be-

- nign Uterine Bleeding with Intracavitary Radiation..... 630
- REDMAN, T. F. Stump Carcinoma: Its Treatment and the Relation Between Parity and Incidence..... 631
- MUELLER, HARRY L., AND FLAKE, CARLYLE G. Irradiation of the Nasopharynx in Children with Infectious Asthma..... 631
- CHARTERIS, ALEXANDER A., AND SOMMERVILLE, JAMES. The Place of Radiotherapy in the Treatment of Simple Skin Conditions..... 631
- BURGER, H. C., ET AL. Depth-Dose Data for Roentgen Radiation at 30-100 Kilovolts..... 632
- KAAB, SIGVARD. The Value of Preoperative Roentgen Irradiation in Operable Breast Cancer..... 632
- HORRAX, GILBERT, ET AL. Chromophobe Pituitary Tumors. II. Treatment..... 632

RADIOISOTOPES

- HOECKER, FRANK E., AND HIEBERT, HOMER L. The Clinical Applications of Radioactive Isotopes in Small Hospitals..... 633
- THOMAS, R. O., ET AL. Dynamics of Calcium Metabolism. Time Distribution of Intravenously Administered Radiocalcium..... 633
- PETERSON, RALPH E., AND MANN, JOSEPH D. Transport of Radioactive Iron in Intestinal Lymph..... 634
- KERMAN, HERBERT D. Medical Uses of Cobalt 60..... 634
- MEREWETHER, HAZEL, ET AL. The Installation of Co⁶⁰ in a Gamma Ray Beam Unit..... 634
- SCHULTE, JOHN W., ET AL. Radiocobalt in the Treatment of Bladder Tumors..... 634
- REILLY, WILLIAM A., AND BAYER, DINA I. The Value of the Measurements of Thyroid Uptake and Urinary Excretion of I¹³¹ in Assessing Thyroid Function of Normal and Congenitally Hypothyroid Children..... 635
- BEDFORD, D. R., ET AL. Recurrent Hyperthyroidism with Thyroid Crisis and Ventricular Tachycardia Successfully Treated with Radioactive Iodine (I¹³¹): A Case Report..... 635
- COPHER, GLOVER H., ET AL. Direct Irradiation of Carcinoma of the Liver and Biliary Tract by the Use of Radioactive Iodine (I¹³¹) in Tetraiodophenolphthalein: An Experimental and Clinical Study..... 635
- SILBERBERG, RUTH, ET AL. Obliterating Tracheitis, a Complication Following Administration of Radioactive Iodine..... 636
- LARSSON, LARS-GUNNAR. Internal Treatment of Mycosis Fungoides with P³²..... 636

RADIATION EFFECTS

- SAENGER, EUGENE L., ET AL. Emergency Measures and Precautions in Radium Accidents... 636
- SULZBERGER, MARION B., ET AL. Do Roentgen-Ray Treatments as Given by Skin Specialists Produce Cancers or Other Sequelae? Follow-Up Study of Dermatologic Patients Treated with Low-Voltage Roentgen Rays..... 636
- CRAWFORD, A. D., ET AL. An Inquiry into the Effects of X-Radiation upon the Heart from Multiple Thoracic Beams..... 637
- SPEERT, HAROLD. The Role of Ionizing Radiations in the Causation of Ovarian Tumors.... 637
- TAYMOR, M. L., ET AL. Effect of Irradiation upon the Uptake of Labeled Phosphorus in Human Carcinoma of the Cervix..... 638
- BURKELL, CHAS. C. Radiation Leukopenia and Cortisone..... 638
- MONKHOUSE, FRANK C., ET AL. Release of Heparin in Anaphylactic Shock in Irradiated and Non-Irradiated Animals..... 639
- JACOBSON, L. O., AND ROBSON, M. J. Factors Effecting X-Ray Inhibition of Antibody Formation..... 639
- KAPLAN, HENRY S., AND PAULL, JANICE. Genetic Modification of Response to Spleen Shielding in Irradiated Mice..... 639
- SMITH, WILLIE W., ET AL. Whole Body X-Irradiation of Obese Mice..... 639
- SHELTON, EMMA. Origin and Behavior of Two Transplantable Lymphomas Induced by X-Radiation..... 640
- DAUER, MAXWELL, AND COON, J. M. Failure of Rutin and Related Flavonoids to Influence Mortality Following Acute Whole Body X-Irradiation..... 640

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Subjective and Objective Criteria in the Diagnosis of Meningiomas of the Brain, with Remarks as to Mortality and Useful Survival. Gilbert Horrax and Richard E. Strain. *Ann. Surg.* 135: 892-898, June 1952.

In a series of 1,146 verified brain tumors seen at the Lahey Clinic between the years 1933 and 1946, 168 (14.6 per cent) were meningiomas. In the first 115 of these patients the predominant complaints were headache, visual disturbances, and convulsions. Localized or unilateral weakness, loss of sense of smell, and ataxia were found in a smaller number of patients.

In a considerable number of cases the presence of meningiomas is manifest on the plain roentgenograms of the skull. The changes include abnormal vascular channels, hyperostoses or enostoses, general thickening of the bone or of one sphenoid wing, calcification within the tumor, and erosion or deformation of the sella turcica. Shift of the pineal gland may be helpful in lateralization. Changes in the spinal fluid protein, air studies (ventriculograms and encephalograms), and angiography may be of diagnostic aid.

One hundred and sixty-seven of the 168 patients had craniotomies, and in 152 the tumors were completely removed as far as could be determined. In 15, the growth had extended widely into bone at the base or was densely adherent to important structures.

Twenty-three patients died in the hospital after operation, an operative mortality of 13.6 per cent. It is interesting to note, however, that among 63 patients operated on between 1942 and 1946 there were only 5 deaths, reducing the mortality rate for that period to 7.9 per cent.

Of the 145 patients who survived operation and left the hospital, 114 (78.6 per cent) are known to have lived five years or more. Eight died from five to eighteen years subsequently, 3 from tumor recurrence and 5 from other causes. Ninety-seven, or 85 per cent, of the 114 five-year survivors had either returned to some useful activity or remained in good or excellent health.

Six roentgenograms; 4 tables.

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Chromophobe Pituitary Tumors. I. Diagnosis.

Omar Z. Younghusband, Gilbert Horrax, Lewis M. Hurxthal, Hugh F. Hare, and James L. Poppen. *J. Clin. Endocrinol. & Metab.* 12: 611-630, June 1952.

The authors present the clinical, laboratory, and roentgenologic findings in 164 cases of chromophobe adenoma of the pituitary. In 105 of these the diagnosis was verified histologically, either at operation or autopsy; in the other 59 cases there was a typically enlarged "ballooned" sella in association either with primary optic atrophy and bitemporal visual field defects or with such unmistakable evidences of pituitary dysfunction as amenorrhea, changes in the skin and hair, cachexia, etc.

In 16 cases the adenoma began before the patient was twenty years of age; 17 patients were between thirty and sixty years of age; 12 were past sixty years of age. Forty-five patients had symptoms for at least five years

and 19 had symptoms for more than ten years before admission to the hospital. There were 81 women and 83 men in the series.

The clinical manifestations of pituitary chromophobe tumor may arise in two ways: (1) symptoms and signs resulting from pressure, extension, or both, of the tumor into adjoining neural structures, especially the optic chiasm; (2) symptoms resulting from hormonal insufficiencies caused by the tumor pressing on or destroying the remaining functioning pituitary tissue, or the hypothalamus, or both.

A visual disturbance was the presenting complaint of 25 patients, but on examination visual disorders were found in 132 patients, varying from a single scotoma to complete blindness. Headache was the second most frequent symptom, occurring in 66.8 per cent of the patients. One of the most frequent symptoms of chromophobe adenoma in women under the age of forty-two is amenorrhea; it occurred in 40 cases in the present series and was the presenting complaint in 16. Loss of libido and potentia, especially in men, is an important symptom. Twenty-four patients complained of "fatigue." A striking pallor or anemia was present in 11 cases.

The main physical changes occurred in the skin, sexual hair, genitalia and fundi. The skin was notably soft and smooth in 52 cases. A striking pallor or sallow appearance, out of proportion to the degree of anemia, was recorded in 41 cases. Thirty-eight patients observed no change in weight; 28 gained weight, the maximal gain following the onset of symptoms being 87 pounds. Twenty-three patients lost weight (maximum loss 84 pounds). In 31 patients the scalp hair was recorded as scant, fine, and silky; in some patients there was a partial loss of eyebrows. In 28 patients, the skin and hair were normal.

The basal metabolic rates in the patients in this series were low, averaging -20 per cent. In the 86 patients tested, only 27 had a basal metabolic reading above -10 per cent. The plasma cholesterol level was determined in 76 cases and averaged 230 mg. per 100 c.c. (slightly above the upper limits of normal), with a range from 144 to 394 mg. per 100 c.c. There appeared to be no direct correlation between the cholesterol level and the basal metabolic rate determination. The fasting blood sugar level was usually low but within normal range.

Roentgenographic evidence of a distorted or enlarged sella turcica associated with ballooning, thinning and depression of the floor, either bilaterally or unilaterally, is of paramount importance in the diagnosis of chromophobe tumors. In only 2 cases in the authors' series was the sella of normal size, and in these thinning or ballooning was present. Because of the marked visual changes, both of these patients were operated on and found to have large extrasellar chromophobe tumors. The area measurements in this series were mainly under 300 sq. mm., although several instances of larger sella, ranging up to 468 sq. mm., were noted. Thinning or absence of the posterior clinoid processes with posterior displacement and depression or breaking through of the floor into the sphenoidal sinus was frequently observed. In only a few cases was a calcified pineal body found to be displaced. Such displacement, in the absence of other causes, is regarded as evidence of a

large tumor with suprasellar extension. Other roentgenologic evidence of increased intracranial pressure is rare. In a few instances, the anterior clinoids were separated, and in unilateral adenomas causing one-sided destruction of the sella, there are sharpening and elevation of the ipsilateral anterior clinoids. When this occurs, it may be indistinguishable radiologically from aneurysm of the internal carotid artery. Exploration or arteriography will establish the diagnosis. It is possible for both conditions to be present.

A review of the cases of enlarged sella turcica found on roentgen examination during the last few years revealed 44 cases in addition to the 164 which form the basis of this study. Some of these may represent asymptomatic chromophobe or inactive mixed tumors.

Treatment is discussed in another paper. For abstract, see p. 632.

Three tables.

Planigraphy of the Temporal Bone. Johannes Zimmer. *Acta radiol.* 37: 419-430, May 1952.

Planigraphy of the temporal bone may demonstrate the size and shape of the antrum and attic regions when they cannot be demonstrated in the usual projections because of superimposition of other structures. The author uses a vertical planigraph, positioning the head by fluoroscopy and then immobilizing it with a band. Sections are taken at 0.5 cm. or less with the patient sitting. Two exposures are made on a 13 × 18 cm. film, in the lateral positions. Planigrams may also be made in the Runström II, Altschul and Stenvers' projections. Bone erosions, fractures, and exostoses, not revealed otherwise, may be disclosed.

Abstracter's Note: The technics described in this paper and in that of Rosendal and Ewertsen (see following abstract) are meticulous. These refinements should probably be used in those cases in which the clinical story is suggestive of bone destruction, which is not demonstrable in the usual projections. The need for such studies becomes less frequent with use of the antibiotics and sulfa drugs, which have largely eliminated the chronic ear infections so often leading to mastoiditis and cholesteatoma.

Twenty-two roentgenograms; 1 drawing.

JAMES H. GROVE, M.D.
Mt. Sinai Hospital of Cleveland

Roentgen Examination of the Temporal Bone for Cholesteatoma. Th. Rosendal and H. Ewertsen. *Acta radiol.* 37: 431-444, May 1952.

The authors compare the various projections for demonstration of the temporal bone which have been described by Schüller, Runström, Stenvers, Towne and Altschul, as well as the more recent technic of Chaussé and a new projection of their own.

In Chaussé's position the central ray is directed to the temporal bone at an angle of 20° caudally and 15° medially, with the back of the head on the film. A very small cone is used and two exposures are made on a 13 × 18-cm. film, non-Bucky. In the position suggested by the authors the central ray is directed through the orbit with the head supine and turned slightly to the side being examined. The ray will thus strike the petrous pyramid at an angle of 45° with its axis. In these two projections the antrum and epitympanicus are seen free of and lateral to the labyrinth.

It is believed that these projections contribute to a more adequate examination of the middle and inner ear. Four cases are cited in which they were of value in demonstrating bone destruction in the antrum and particularly in disclosing a fistula into the lateral semicircular canal which was seen only in the new orbital view.

Sixteen figures, including 22 roentgenograms.

JAMES H. GROVE, M.D.
Mt. Sinai Hospital of Cleveland

Cleidocranial Dysostosis Associated with Osteosclerosis and Bone Fragility. Gregers Thomsen and Mariano Guttadauro. *Acta radiol.* 37: 559-567, June 1952.

Two cases of cleidocranial dysostosis associated with generalized osteosclerosis and bone fragility are recorded. Widespread abnormalities of bone structure were present in both patients. Deficient ossification was manifest by large defects of the cranial vault, persistent sutures and fontanelles, and the presence of wormian bones. Also there was slight shortening of the acromial ends of the clavicles. In addition to defects of bone formed in membrane, there were deficiencies of bone formed in cartilage. Generalized osteosclerosis was present in both cases, though to a considerably greater degree in one patient. Multiple fractures occurred, the patient with the more marked sclerosis having sustained the greater number.

In both these cases the true cause of sclerosis was undetermined. Serum calcium and phosphorus were within the normal range, and no abnormality was revealed in an examination of the formed elements of the blood.

Six roentgenograms; 1 photograph.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Radiography of the Supraglottic Speech Organs. A Survey. Alexander S. MacMillan and George Kelemen. *Arch. Otolaryng.* 55: 671-688, June 1952.

This paper is devoted largely to a comprehensive review of the literature on the roentgen examination of the supraglottic speech organs, with emphasis on the technical aspects of the problem. The authors include a description of the technic employed in the Department of Otolaryngology of the Massachusetts Eye and Ear Infirmary, which has been found to yield satisfactory results.

The outlines of the tongue, the roof of the mouth, and the pharyngeal wall are made visible by giving the patient a mixture of barium and water, to which mucilage of acacia has been added. This mixture is applied by spatula, and the patient is asked to smooth over the surface with his tongue to get an even distribution. It is essential that the head be held in a natural speaking position and that the same position be maintained throughout the entire procedure. The head should not be fixed by a clamp or by any other device in a strained position. In the upright position, the head is placed against a headrest at the occipital region. The lower edge of the cassette rests against the side of the shoulder (against the deltoid) at a distance of about 22 cm. from the sagittal midline of the face. To prevent distortion produced by this distance between the subject and the cassette, the x-ray tube is removed to 2 meters. The central ray is directed through the crown of the first

upper molar. With the central ray held constant, one can duplicate the work from day to day. A rotating tube is used, and the exposure time is $1/30$ second, with 75 kv. and 480 ma. Films are developed by the usual standard vacuum technic. Tracings are made on transparent paper over a highly illuminated viewing box. The fix points, such as the occlusal surface of the upper incisors, the roof of the mouth, the position of the tip of the tongue, the dorsum and base of the tongue, and the position of the soft palate are sketched, together with the outlines of the posterior pharyngeal wall, the epiglottis, and the arytenoids.

A bibliography of approximately 90 references; 3 tables.

THE CHEST

Actual Applications of Angiopneumography. Melot, De Clercq, Bollaert, and De Coster. *J. belge de radiol.* 35: 434-456, 1952. (In French)

Contrast visualization of the pulmonary circulation reveals interesting data in many patients. In primary bronchogenic carcinoma there is usually an "amputation" of relatively large pulmonary vessels. When this occurs within 1.5 cm. from the primary bifurcation, or when the superior vena cava is involved, the case is usually inoperable. Hodgkin's disease, as well as other mediastinal tumors, may not impinge upon the circulation. Exudative forms of tuberculosis exhibit hyperemia, thus indicating maximum penetration of chemotherapeutic and antibiotic agents. Patients with cavities, fibrotic or emphysematous changes, as well as those who have a shifting of the mediastinum, exhibit varying degrees of hypovascularity.

Nine illustrative cases are reported, with 27 roentgenograms.

CHARLES M. NICE, M.D.
University of Minnesota

A New Method of Bronchography with Water Soluble Contrast. Björn E. W. Nordenström. *Acta radiol.* 37: 452-458, May 1952.

A new type of catheter designed to aid in upper lobe bronchography is described. The catheter, which is of rubber, is about 50 cm. long, has a curved radiopaque tip and two canals. The smaller canal is connected to a series of three balloons: two small thin-walled balloons near the tip and one larger thick-walled balloon at the upper end of the catheter. The larger canal has a side opening between the two distal balloons.

The communicating system between the three balloons by way of the smaller canal is filled with water, a non-viscous contrast solution, or air and then closed. By squeezing the large balloon the two smaller balloons are distended, sealing the bronchus above and below. A clamp is then placed to maintain the distention. After the procedure, the clamp is released and the larger balloon will suck up the contents of the two small ones.

If the catheter is placed so that the side opening between the two small balloons is opposite the upper lobe orifice, then it is possible to obtain a more positive filling of the upper lobe and the apical branches of the lower lobe. The patient can be moved freely without danger of dislodging the catheter, and the examination can be done in the sitting position. It is more difficult to use the catheter on the right side because of the shorter distance between the upper lobe orifice and the trachea.

Occasionally dislocation of the catheter so that the upper small balloon blocks the trachea may result in severe dyspnea, in which event rapid deflation of the balloons is indicated. As in other methods of bronchography, cardiorespiratory insufficiency is an absolute contraindication to the procedure.

After radiography of the contrast-filled bronchi, it is possible to obtain films of the bronchial mucosa by the injection of air. Following deflation of the small balloons, the medium will flow down into the bronchi of the lower lobe, which may then be examined.

The principle of the technic resembles that of differential bronchospirrometry. The author uses a water-soluble contrast material.

[While this technic may not be necessary for most upper lobe examinations, it may be of distinct help in those instances of segmental disease where information concerning the patency of a particular branch bronchus may be critical.—G.R.K.]

Four roentgenograms; 3 photographs.

GEORGE R. KRAUSE, M.D.
Mt. Sinai Hospital of Cleveland

Results of an International Test in Chest Roentgenogram Interpretation. L. H. Garland and A. L. Cochrane. *J.A.M.A.* 149: 631-634, June 14, 1952.

Recent studies among experienced readers have shown a significant variation concerning errors in film interpretation. In order further to investigate this problem, an international test was undertaken.

Six British and 3 American observers examined eighty-nine 14 × 17-inch chest radiographs supplied by the Welsh National Memorial Association. On two independent occasions the reader listed a report of each film as T.B. absent, T.B. present, process active, process inactive, or process of clinical significance.

Statistical analyses of the results showed that the American readers tended to stress minimal abnormal shadows to a greater extent than the British, with a mean of 20.7 and 13.6 active cases, respectively. This was explained by a more extensive previous experience on the part of the American group with minimal tuberculous lesions.

The degree of interindividual and intraindividual disagreement was significant and of about the same magnitude in the two groups. There was a percentage disagreement between any pair of readers of 7.7 per cent of the total number of films read by the British as compared to 13.5 per cent for the Americans.

The mean degree of personal inconsistency in seeing a lesion was 4.3 per cent of all cases for the British and 5.2 per cent for the Americans.

It is concluded that observer error in chest roentgenographic interpretation is a significant problem in more than one country, and that methods should be developed to reduce this error.

Seven tables. EDWARD E. TENNANT, M.D.
Jacksonville, N. C.

Pulmonary Tuberculosis Following Resection for Nontuberculous Disease. Emil Rothstein and Charles E. Gerson. *J. Thoracic Surg.* 23: 575-581, June 1952.

Pulmonary tuberculosis following resection for nontuberculous disease has received very little emphasis in medical literature. In several series of cases cited by the authors this late complication proved to be not infrequent and to be associated with serious and often fatal results.

Two cases are added to those previously reported, both in patients undergoing lobectomy for bronchiectasis. Sputum studies prior to surgery were negative for tuberculosis bacilli and no foci of the disease were found in the resected specimens. Nonetheless, both patients were found to have far advanced tuberculosis within a year, and one of them died from the disease. The other was seriously ill with active tuberculosis at the time of the report.

The pathogenesis of this complication is undetermined. One possibility, considered by the authors to be quite likely, is over-distention of the remaining lung, in which there may be unsuspected foci of quiescent tuberculosis. In view of the possibility of a postoperative tuberculosis, all the normal lung possible should be conserved. The surgeon should avoid over-distending the residual lung any more than is absolutely necessary and may even consider performing a thoracoplasty to reduce the resultant volume of thorax. All post-lobectomy or post-thoracic surgery patients should be followed with frequent chest films to detect the possible development of pulmonary tuberculosis.

Four roentgenograms. C. J. CORRIGAN, M.D.
St. Paul, Minn.

The Roentgen Findings in Atelectasis of the Newborn, with Special Reference to Changes in the Cardiac Silhouette. James F. Martin and Hymer L. Friedell. *Am. J. Roentgenol.* 67: 905-923, June 1952.

"Physiologic atelectasis" is present in normal full-term infants following the initial inspiratory effort, which inflates sufficient alveoli to sustain life; this atelectasis disappears over a period of two to six days as the remaining alveoli gradually expand. In premature infants, however, complete expansion of the alveoli may require as long as six weeks.

Various factors prevent the normal expansion of the lungs in the newborn. Congenital atelectasis is of two types: that in which mature alveoli have never contained air and that in which varying amounts of immature pulmonary tissue exist. Acquired atelectasis is nearly always due to bronchial occlusion and absorption of air distal to the point of obstruction; it is also referred to as resorption atelectasis.

The authors present a discussion of each of five major roentgenographic observations in atelectasis of the newborn: (1) Lung findings range from extensive, homogeneous opacities to disseminated, finely mottled areas of increased density, the former of which are more likely to be found in the premature infant. Occasionally basal and peripheral emphysema is seen. One of the most consistent findings is partial or complete obliteration of the usual sharp cardiac margins, due to projection of atelectatic lung over the cardiac silhouette. (2) With resolution of atelectasis the mediastinum gradually becomes narrower as the expanding lungs cause molding and elongation of the thymus. This is more apparent in cyanotic than in normal infants, in whom it is also observed to some degree. Because of bilateral distribution of congenital atelectasis, mediastinal shift does not always occur but is present when there is marked unilateral involvement. (3) The diaphragm is elevated in severe atelectatic involvement of one lung. With increasing aeration it may become irregular and flattened. (4) Narrowing of intercostal spaces occurs in severe unilateral atelectasis but is not a constant finding in disseminated atelectasis of severe degree. Cases of the

former type show some degree of asymmetry or deformity of the bony thorax, which is more marked when the muscle tone is poor or absent. (5) Cardiac enlargement occurs secondary to atelectasis in the newborn. The authors are primarily concerned with this finding.

Thirty-three normal full-term newborn infants and 12 cyanotic full-term newborn infants were studied roentgenographically under carefully controlled technical conditions. The transverse diameter of the heart and chest and the length of the thorax were measured; the cardiothoracic ratio was calculated. The normal infants were examined on Day 1 and again on Day 3. Their cardiothoracic ratios on Day 1 were significantly greater than on Day 3. Sixteen of these infants were re-examined on Day 5; no significant difference between Day 3 and Day 5 cardiothoracic ratios was observed, indicating that a state of stability had been reached. Comparison of the ratio in one-day-old normal and cyanotic infants revealed a larger figure for the cyanotic group. In this group at Day 4 to 6 the ratio was less than at Day 1 but greater than that of normal infants at Day 3, indicating that a normal figure had not yet been reached.

The conclusion drawn from these data is that in normal infants the lungs continue to expand through Day 3, and by Day 5 expansion is complete. Enlargement of the cardiac silhouette in the cyanotic newborn is believed to be related to incomplete initial expansion of the lungs with its associated anoxia, tachycardia, and altered intrathoracic pressure. The enlargement diminishes as atelectatic lung is aerated.

Eight case reports are included.

Twenty-three roentgenograms; 2 photomicrographs; 1 chart; 4 tables.

DORIS E. PIPKIN, M.D.
University of Louisville

Cystic Disease of the Lungs. Francis N. Cooke and Brian Blades. *J. Thoracic Surg.* 23: 546-569, June 1952.

This is a rather comprehensive discussion of cystic disease of the lungs. The authors present a short review of the literature and point out the difficulty in determining the incidence of the condition because of the confusion of terms. Roentgen estimates of the incidence are inaccurate inasmuch as many pulmonary cysts are not revealed on routine films.

In discussing the confusion that at present obtains regarding the correct nomenclature of this disease, the authors mention that at the Armed Forces Institute of Pathology, Washington, D. C., there are twenty-eight synonyms under which cases of cystic disease of the lungs are filed. They add nine other synonyms which they have gleaned from the literature. With the hope of helping to clarify the situation, they present the following classification, using terms already common in the literature:

- I. Congenital Pulmonary Cysts
 - A. Bronchogenic cell type
 1. Solitary
 2. Multiple
 - B. Alveolar cell type
 1. Solitary (balloon cyst, pneumatocele)
 2. Multiple
 - C. Bronchogenic and alveolar types combined
- II. Acquired Pulmonary Cysts
 - A. Bullous emphysema
 - B. Subpleural blebs

Congenital cysts, when they are small, diffusely scattered, and in communication with the bronchi, give a roentgen appearance of saccular bronchiectasis on bronchography. Superimposed infection often makes diagnosis difficult, particularly if the infection is of long standing. There are certain features in which the congenital malformation differs from acquired bronchiectasis. In the latter the dependent portions of the lung are most frequently involved. In congenital cystic disease of the small diffuse type the upper lobes are often the site of the lesion. In the congenital disease the cystic areas are in most instances of uniform size, as compared to both the tubular and saccular dilatations seen in acquired bronchiectasis.

Large solitary cysts of bronchogenic origin are frequently found projecting from the mediastinum. Some of these cysts have on occasion been classified as accessory lobes or accessory lungs. In the classification proposed here, mediastinal cysts of bronchogenic origin have purposely been excluded.

Cysts of the alveolar type always communicate with a bronchus. They are chiefly air cysts and produce symptoms by encroaching on normal lung tissue. Spontaneous cures have been reported, and such a case is reported in this paper. These cures may occur as a result of closure of the bronchial communication and resorption of the air, with obliteration of the cyst.

The large solitary balloon cysts are distinguished from emphysematous bullae by the fact that the balloon cyst is completely lined with alveolar cells and as a rule has a single bronchial communication. All adjacent pulmonary segments are anatomically normal except for a compression atelectasis. The differential diagnosis is important because of the difference in prognosis and management.

Emphysematous bullae are the result of a breakdown of the interalveolar septa with the formation of cystic areas within the lung parenchyma. The air space is not lined by squamous cells, as in the balloon cyst of the congenital type, but with disintegrating lung parenchyma. Fine blood vessels completely stripped of supporting lung parenchyma can be seen to cross the air sac. Multiple small communications with the adjacent bronchi are apparent.

Subpleural blebs are the result of rupture of the elastic fibers which bind the pleura to underlying lung parenchyma. They characteristically occur at the apices of the lung. It has been suggested that the subpleural bleb may be a precursor of the emphysematous bulla. Rupture of subpleural blebs is the most frequent cause of spontaneous pneumothorax.

The authors indulge in some theoretical considerations as to the methods of development of blebs and bullae and balloon cysts. They present several cases of congenital and acquired cystic disease and the results of surgery.

This paper is well written and clearly presented and, in view of the simple classification, is well worth reading in its entirety.

Seventeen roentgenograms; 10 photographs and photomicrographs; 3 tables.

C. J. CORRIGAN, M.D.
St. Paul, Minn.

Roentgenography of the Soot Lung. R. Töppner. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 76: 722-728, June 1952. (In German)

Chest roentgenograms of 334 workers in a soot (or

lampblack) factory were analyzed. The components of the soot were carbon (92-98 per cent), hydrogen, oxygen, sulfur, and nitrogen. Clinical complaints among the workers were relatively slight. A few had only exertional dyspnea.

The roentgenograms initially show increased pulmonary markings consisting of soft shadows in a pattern of stripes or a network, with fine small patches appearing subsequently. The slow progress of the changes and the absence of initial emphysema are characteristic. The roentgen findings in a worker who committed suicide were confirmed at autopsy. Marked emphysema and subpleural soot deposits were found. The cut surfaces were black. Microscopically the soot was deposited in perivascular and peribronchial tissue structures, and in small clusters of alveoli. The sparse and slight induration explains the soft shadows cast by the increased markings. The pathologic appearance corresponded to that of a severe anthracosis.

Three roentgenograms; 2 photomicrographs.

LEWIS L. HAAS, M.D.
Chicago, Ill.

Pulmonary Fibrosis in Generalized Scleroderma. Report of a Case and Review of the Literature. Louis D. Hayman and Robert E. Hunt. *Dis. of Chest* 21: 691-704, June 1952.

Generalized scleroderma is a progressive fibrosing disorder of collagenous tissue, the fundamental pathological change being a sclerosing lesion of the connective-tissue framework of the skin and other organs. The authors report the case of a 36-year-old white male with pulmonary involvement, and tabulate the more important findings of 27 other cases of pulmonary scleroderma recorded during the past eleven years.

Clinically, scleroderma usually begins in one of two ways: (1) with gradual onset of Raynaud-like phenomena, usually involving the hands, and sometimes the feet; (2) as an acute or subacute illness with an arthralgia, arthritis, or myalgia, and subsequent development of Raynaud-like phenomena. Cutaneous changes subsequently appear, with thickening of the skin of the hands, forearms, face, upper chest, and sometimes of the abdomen, feet, and legs. Visceral involvement, producing symptoms, occurs most often in the lungs, heart, esophagus, and gastrointestinal tract.

Pulmonary dysfunction is manifested by progressive exertional dyspnea, and a slight productive cough. Symptoms of pulmonary scleroderma may precede skin changes, and roentgen evidences of pulmonary fibrosis may precede pulmonary symptoms.

The early roentgen features are slight diffuse mottling and interlacing linear shadows in the lower lobes. In the advanced cases there is a diffuse and usually symmetrical net-like shadow throughout the lower two-thirds of the lung fields, increasing in density toward the bases. At times, cysts may be demonstrated. The cardiac and diaphragmatic contours are often irregular and thickened due to adhesions.

Pathological studies in 7 cases coming to autopsy showed the essential changes in the lungs to consist in a diffuse alveolar wall sclerosis and alveolar obliteration. The involved lobes were firm, inelastic, and reduced in size. Two cases showed multiple small subpleural cysts. Fibrous replacement of the muscular coats in smaller bronchi and narrowing of the lumina of pulmonary vessels have been observed.

The etiology is unknown. Progressive interstitial fibrosis of the lungs does not occur in disseminated lupus erythematosus, dermatomyositis, rheumatic fever, rheumatoid arthritis, serum sickness, or polyarteritis nodosa.

In obscure cases of chronic interstitial fibrosis of the lungs, generalized progressive scleroderma should be kept in mind.

Three roentgenograms; 2 photographs; 1 table.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Pulmonary Amoebiasis. Amal Chakravarti. J. Indian M. A. 21: 387-395, June 1952.

The author presents a series of 12 cases of pulmonary amebiasis, tabulating the clinical, laboratory, and radiologic findings.

In the case of secondary invasion of the lung, the involvement is in the right side of the chest, appearing radiologically as a triangular pneumonic opacity above the diaphragm or in juxtaposition to it, tapering toward the hilus. There may or may not be a basally situated abscess cavity. In either event the dome of the diaphragm may show a pointed projection or a humped appearance.

In amebiasis involving the lung primarily, the radiological findings are not necessarily limited to the basal area. The homogeneous opacities in such cases, therefore, present a closer resemblance to pulmonary tuberculosis. Because of embolic origin, the abscess cavities are multiple and hence require differentiation from other embolic abscess cavities.

Sixteen roentgenograms.

Intrathoracic Goiter. Report of a Case. Edward A. Fitch, W. D. Seybold, and Mavis P. Kelsey. Texas State J. Med. 48: 334-336, June 1952.

An intrathoracic goiter, measuring $21.5 \times 12.0 \times 7.0$ cm. and weighing 1,020 gm., was removed surgically from the mediastinum of a 60-year-old woman. Roentgenograms had revealed the presence of a large bilateral mediastinal tumor. The correct diagnosis was suggested by a history of nodular goiter in the neck for which a subtotal thyroidectomy had been performed several years previously, the anterior mediastinal position of the mass, and its upward movement during the act of swallowing. The large uptake of a tracer dose of radioactive iodine established the thyroid nature of the tumor. Ready surgical approach was afforded by a midline sternum-splitting incision.

Two roentgenograms; 1 photograph.

Systolic Expansion of the Left Auricle in Mitral Regurgitation. Milton Elkin, Merrill C. Sosman, Dwight E. Harken, and Lewis Dexter. New England J. Med. 246: 958-961, June 19, 1952.

Systolic expansion of the left auricle should occur in mitral regurgitation, as contraction of the left ventricle forces a jet of blood backward through the incompetent valve. Two positions may be used to demonstrate this phenomenon fluoroscopically. In the anteroposterior view, the left auricle, if it is large enough to form a double contour on the right heart border, will be seen to alternate in movement with the right (unless of course there is also tricuspid regurgitation), giving a "see-saw" effect. In the standard right anterior oblique position,

the esophagus (outlined with barium) will be displaced backward along the posterior cardiac border simultaneously with the inward movement of the anterior border in systole.

Twenty-nine patients with fluoroscopic evidence of systolic expansion of the left auricle, who subsequently underwent valvuloplasty, were observed. Clinically a diagnosis of mitral insufficiency was considered in 8, and in 14 the surgeon based the diagnosis on perception of the regurgitant jet of blood felt as his finger approached the orifice. In 12 cases the systolic pressure was below 80, which it was felt might have resulted in failure to feel the jet.

Transmitted pulsations from an enlarged and vigorous right auricle or ventricle, a very large and tense left auricle, and mural thrombus are all possible causes of misinterpretation, the first leading to a falsely positive diagnosis; the others, falsely negative.

During the period of the authors' study, 7 patients were examined in whom systolic expansion was not seen fluoroscopically, though the clinical and surgical findings left no doubt as to the presence of mitral regurgitation.

It is concluded that the demonstration of systolic expansion of the left auricle at careful fluoroscopy is valuable evidence of mitral regurgitation, although the absence of this sign does not have great diagnostic significance.

[This simple procedure may well provide useful information in mitral valve disease. One wonders why the authors did not put it on a more objective basis by using roentgenkymography along with fluoroscopy.—Z.F.E.]

Two drawings; 2 tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Infundibulum of the Patent Ductus Arteriosus Studied by Thoracic Aortography. Gunnar Jönsson and Georg-Fredrik Saltzman. Acta radiol. 37: 445-451, May 1952.

The authors employed thoracic aortography in 27 cases of patent ductus arteriosus. In 25 of these an infundibulum was demonstrated, varying from a marked funnel-shaped formation to a shallow bulge in the aorta where the ductus begins. In 2 cases a uniform widening of the upper part of the descending aorta was observed.

Since the ductus usually runs, for the most part, in a dorsal-ventral direction, the infundibulum is best seen in the lateral view. In most cases, however, the point of origin of the ductus from the aorta is located somewhat medially to the point where it enters the pulmonary artery. Thus, because the path of the ductus is slightly oblique, medial to lateral, the infundibulum is often demonstrable in the anteroposterior view as a bulge on the left border of the aorta. In a few cases visualization was more satisfactory in this projection.

As a rule, the ductus arises from the region where the aortic arch passes over into the descending aorta. There are exceptions, however, and the authors mention a case in which the ductus arose from the middle of the arch.

In 3 out of 4 normal subjects in whom thoracic aortography was performed, a shallow bulge projecting for not more than 1 mm. was seen at the point of insertion of the ligamentum arteriosum into the aorta. In these cases no deformation of the aortic shadow was visible in the anteroposterior view.

The authors conclude that the demonstration of the infundibulum is often the only way in which the exact position of the ductus can be ascertained.

Nine roentgenograms.

ALVIN J. GREENBERG, M.D.
Mt. Sinai Hospital of Cleveland

The Leriche Syndrome (Thrombotic Obliteration of the Aortic Bifurcation). David Shapiro. *Am. J. Roentgenol.* 67: 891-904, June 1952.

Chronic thrombotic obliteration of the aortic bifurcation must be distinguished from acute embolic occlusion at this site. The latter condition is sudden in onset, with acute symptoms and violent pain. The sequelae are rapid and severe. In contrast, the onset and symptoms of thrombotic obliteration (Leriche syndrome) are insidious, and the development of the condition is measured by years. By means of abdominal aortography the radiologist can outline the site and extent of the lesion and the state of the collateral circulation, thus aiding in its surgical treatment.

The etiology of the Leriche syndrome is obscure. Leriche believes it to be a true arteritis, but others claim that arteriosclerosis is the cause. Various arguments for each theory are presented. The author believes that the etiology is yet to be determined.

Frequently, the thrombus begins in one of the common iliac arteries, extends upward, and then reaches the opposite iliac artery. In any event, the terminal aorta becomes obliterated and the common iliacs are hard and cord-like. By extension, the inferior mesenteric artery is frequently involved and occasionally the renal arteries are affected.

This is a disease of males between forty-five and sixty-five years, manifested by fatigability and coldness of the lower extremities, pain in the legs, and inability to maintain a stable erection. Signs include absence of peripheral pulsation in the femoral artery and sometimes in the abdominal aorta, murmurs over the involved segments, pallor of the legs even on elevation, symmetrical atrophy, trophic changes, and gangrene late in the disease.

Abdominal aortography should be performed to confirm the diagnosis and fix the site and extent of the thrombus. The author describes the technic used. Contraindications to the procedure are marked obesity, cardiac failure, cyanosis of the feet and legs. Aortography in these cases may lead to extension of the thrombosis.

Treatment is not entirely satisfactory, since resection of the thrombus and bridging with a graft are not usually possible. At present, bilateral lumbar sympathectomy is used, and Leriche recommends, in addition, resection of the thrombosed vessels. Death usually results from gangrene, coronary occlusion, or involvement of the renal arteries with its complications.

The author presents 6 cases.

Eleven figures, including 7 roentgenograms; 1 table.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Slit-Kymographic Evidence that Nitroglycerine Decreases Heart Volume and Stroke Volume While Increasing the Amplitude of Ballistocardiographic Waves. J. L. Brandt, A. Caccese, and W. Dock. *Am. J. Med.* 12: 650-658, June 1952.

Using the standard slit kymograph with slits 12 mm. apart, the authors recorded the cardiac anteroposterior

roentgen silhouette in 6 subjects in the erect position, before and six minutes after putting 0.6 mg. of fresh nitroglycerine under the tongue. Method A of Keys *et al.* (*Am. J. Roentgenol.* 44: 805, 1940) was used for calculating volume and stroke from these films. Employing a special kymograph for recumbent subjects, similar films with synchronous ballistocardiograms were recorded in 4 subjects before and six minutes after nitroglycerine; and in 1 subject two control films as well as five- and eight-minute films were made. The ballistocardiograms were made directly, and were recorded simultaneously on the x-ray film and on a direct-writing galvanometer.

On another occasion subjects used in tests with the slit kymograph were studied before and three, five, eight, and ten minutes after nitroglycerine with the same displacement ballistocardiograph and simultaneously with an electromagnetic velocity ballistocardiograph.

Nitroglycerin, like amyl nitrite and sodium nitrite, given in doses which accelerate the pulse was found to decrease stroke volume and heart volume. The effect on minute volume is variable but the increase is never large with any of these drugs.

On the basis of the present investigation, the authors conclude that the ballistocardiograph yields misleading data when stroke volume is calculated during action of drugs or diseases which alter duration or force of systole, or the arterial resistance or venous return.

The clinical value of the ballistocardiograph lies in its sensitivity to velocity of systolic ejection, which no other method of study duplicates, and not in estimating stroke volume. The slit kymograph may be more useful in estimating the changes in heart volume and in stroke volume occurring under drug action than in absolute measurements of either volume or stroke.

Seven figures, with 4 kymograms; 3 tables.

THE DIGESTIVE SYSTEM

Roentgenologic Appearance of Neurogenic Tumors of the Digestive Tract. R. Pape and H. A. Hackensellner. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 76: 691-711, June 1952. (In German)

The frequency with which neurogenic tumors of the digestive tract are being diagnosed is increasing. A great help in histological differentiation is the recent method of Feyrter, which stains myomas blue and neurogenic tumors pink. Recent studies reveal that in the digestive tract neuromas are next in frequency to epithelial tumors. In 2,028 specimens from the Wilhelminen Hospital, Vienna, obtained by resection in 1931-50, epithelial tumors were found in 419 and non-epithelial tumors, of which 9 were neuromas, in 16 cases. The authors have observed clinically 20 cases, of which 10 occurred in the stomach, 5 in the small intestine, and 2 in the rectum. In 1 case the lesion was associated with generalized neurofibromatosis. In 2 cases the diagnosis was only tentative.

The roentgen differentiation into endo- and exogastrintestinal types (growing in an extramucosal or subserous direction) is clinically important. Bleeding is frequent, but roentgen examination cannot demonstrate the ulceration in every bleeding case. In the endo-gastrintestinal form, the filling defect is deep-concave, with smooth or serrated contour. In the exogastrintestinal type the filling defect is flat-concave, angle-like, or polycyclic. Funnel, niches, diverticula,

and cavities were observed in some cases. Malignant change is not rare.

Eleven roentgenograms; 6 photographs; 10 drawings.

LEWIS L. HAAS, M.D.
Chicago, Ill.

Carcinoma of the Cardia of the Stomach as Detected by Laminagraphy. Robert L. Friedman and Milton G. Wasch. *Am. J. Roentgenol.* 67: 932-941, June 1952.

When unusual findings are demonstrated in the gastric cardia by routine roentgenographic measures but no definite diagnosis can be made, the authors have found laminagraphy helpful.

The patient is placed on the Kieffer laminagraphic table in the supine position. His stomach is inflated with air, by way of a Levin tube, until he feels the desire to eructate. Films are made in the range of 10 to 15 cm. from the table top. Such films show a tumor as a soft-tissue shadow with scalloped margins outlined by the contrasting air filling the cardia. An extrinsic mass protruding upon the cardia presents a smooth margin.

Thirteen cases are tabulated as to history, roentgen examination, operative findings, and pathology report. Five of the cases are presented in detail together with roentgenograms. Laminagraphy definitely established evidence of tumor in 10 cases. In the remaining 3 cases the procedure was unsuccessful. In one instance the "lesion" proved at operation to be liver pressing upon the cardia. Laminagraphy was impossible in the second case because of failure of air to remain in the stomach. In the third case a flat serpiginous neoplasm, which was not demonstrated roentgenographically, was found at operation.

Ten roentgenograms; 3 photographs; 1 table.

DORIS E. PIPKIN, M.D.
University of Louisville

Gastric Lipoma. Donald H. Badner and Max Caplan. *Surgery* 31: 909-914, June 1952.

A case of gastric lipoma in a 56-year-old man is presented; this is believed to be the fifty-fifth such case recorded in the literature. The patient was admitted to the hospital with vague digestive complaints associated with weakness and weight loss. A gastrointestinal series revealed a filling defect in the prepyloric region of the stomach, with some apparent rigidity of the lesser curvature of the stomach overlying it. The diagnosis was gastric polyp and, because of the suggestion of fixation of the gastric wall, cancer was considered a possibility. At gastrotomy, a well encapsulated lipoma was seen submucosally, protruding through the incision. The lipoma was easily removed, and the patient made an uneventful recovery.

One roentgenogram; 1 photograph.

Gastric Lesion of Loeffler's Syndrome. Report of a Case with Inflammatory Lesion Simulating Carcinoma.

Jay P. Ruzic, John M. Dorsey, Harry L. Huber, and S. Howard Armstrong, Jr. *J.A.M.A.* 149: 534-537, June 7, 1952.

Since 1942, when Loeffler first described the syndrome of shifting roentgenographic pulmonary findings, peripheral eosinophilia, and mild general symptoms, many variations of this disease have been presented. A basic allergic mechanism involved in this syndrome may explain similar findings in cases where the eosinophilic

infiltrations involve other organs. Infiltration of the stomach occurred in the following case.

A 53-year-old male, who had a long-standing history of asthma, had an episode suggestive of Loeffler's syndrome involving the lungs in 1947, which required hospitalization. He was seen in 1949 for a gastrointestinal upset of three weeks duration. Eosinophilia of over 50 per cent, increased sedimentation rate, and bronchial asthmatic signs were noted on admission. A large filling defect was seen on the lesser curvature of the stomach. Surgery was deemed necessary for possible gastric carcinoma, although absence of blood in the stools, eosinophilia, and the allergic history suggested the possibility of a benign condition.

At surgery the stomach wall was found to be thickened, of a red-brown color, with miliary elevated yellow-brown plaques throughout the area of involvement. The pathological specimen following gastrectomy revealed a serosal inflammatory reaction with perivascular infiltration of lymphocytes, macrophages, and giant cells, with many eosinophilic cells. Abdominal muscle biopsy was negative for periarteritis. A follow-up fluoroscopic examination was negative.

Several cases have been reported with findings similar, although not identical, to those in the authors' patient.

Four roentgenograms.

[The authors' patient had received Aureomycin, and a Letter to the Editor in *J.A.M.A.*, July 19, 1952, by Sidney A. Portis, of Chicago, suggests that the gastric lesions may have been due to that drug. Dr. Portis has himself seen severe edematous pseudopolypoid changes in the stomach of a patient following copious dosage of Aureomycin.]

EDWARD E. TENNANT, M.D.
Jacksonville, N. C.

"Upside Down Stomach": Rare Form of Diaphragmatic Hernia. Report of a Case. Raymond A. Gagliardi. *Gastroenterology* 21: 300-303, June 1952.

A case is reported in which the stomach and duodenum had herniated into the thoracic cavity and the esophagus entered the fundus of the stomach below the diaphragm, thus producing an "upside-down" appearance. The patient was a 72-year-old male complaining of epigastric pain of a years duration, unrelated to position, relieved by belching after taking antacids. Fifteen years earlier the patient had sustained a steering-wheel type of injury, suggesting a possible traumatic etiology. Upper gastrointestinal x-ray demonstrated and established the relationship of the lower esophagus to the fundus. Cholelithiasis was also present.

The author recommends the recumbent or slight Trendelenburg position for demonstration of the various components of a diaphragmatic hernia. For study of the distal esophagus and its relation to the hernia, it is suggested that films be obtained with the patient supine, immediately after he swallows a thick barium mixture, before the exposure of the stomach film.

Three roentgenograms.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

Clinical Significance of Heterotopic Pancreas in Wall of Stomach. Report of a Case and Review of the Literature. Marvin Wagner. *Arch. Surg.* 64: 840-846, June 1952.

Heterotopic pancreatic tissues have been found in the

stomach, gallbladder, spleen, mesentery, omentum, ileum, duodenum, jejunum, Meckel's diverticulum, liver, and cystic duct. The stomach, duodenum, and jejunum are the commonest sites. This heterotopia may cause hemorrhage, diverticulum formation, inflammation, fat necrosis, and ulceration in the adjacent structures. Malignant changes are more likely to take place in the heterotopic tissue than in the pancreas proper. The symptoms usually suggest gastric or duodenal ulceration, or gallbladder disease. The most frequent roentgen diagnosis is polyp. Simple, local excision when the pancreatic tissue is duodenal or gastric and complete extirpation for other locations is advised.

The author reports a case in a 62-year-old woman with upper gastrointestinal symptoms whose stomach contained two nodules of pancreatic tissue originating in the submucosa and extending through the muscle into the serosa. This operative specimen showed a peculiar alteration of the gastric mucosa, consisting of a mound-like projection, described by Benner (*Surgery* 29: 1701, 1951) as a pseudo-diverticulum, overlying the aberrant tissue. The author believes that if the gross characteristics are kept in mind, this will be of aid to the surgeon in the recognition of heterotopic pancreas involving the stomach.

Two roentgenograms; 3 photographs; 2 photomicrographs.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Partial Gastrectomy With and Without Vagus Resection in Treatment of Duodenal Ulcer: Comparative Analysis of Results of Gastrectomy Alone and Combined with Infradiaphragmatic Vagus Resection. Louis T. Palumbo, R. E. Paul, and G. T. Westly. *Arch. Surg.* 64: 756-765, June 1952.

A comparative study of the results of partial gastrectomy in 99 patients and the results of partial gastrectomy and bilateral infra-diaphragmatic vagus resection in 30 patients treated for duodenal ulcer is presented. The two groups are compared as to age, duration of symptoms, complications, postoperative mortality, and other factors.

This preliminary report, made after an average follow-up period of two to three years, showed absence of free hydrochloric acid in all of the gastrectomy-vagotomy group and in 91 per cent of the partial gastrectomy group. Emptying time for the latter group averaged one hour and for the other group four hours. One-third of the gastrectomy-vagotomy group showed hypomotility of the small bowel, with puddling, clumping, and segmentation of the barium in the small bowel.

Two cases of marginal ulcer developed in the partial gastrectomy group and none in the other.

The dumping syndrome occurred equally often in the two series, but the most troublesome complaint in the gastrectomy-vagotomy series was diarrhea.

Comparative data are presented in 5 tables.

Eight roentgenograms. DORIS E. PIPKIN, M.D.
University of Louisville

Benign Giant Duodenal Ulcer. W. K. Bullock and Edward N. Snyder, Jr. *Gastroenterology* 20: 330-336, February 1952.

The authors report the case of a 66-year-old white male with a benign giant duodenal ulcer which on gross

examination of the surgical specimen simulated carcinoma. This case is presented because of its rarity and difficulty of diagnosis. The literature reviewed by the authors indicates that their case is the fifth one of benign giant duodenal ulcer reported.

In order to establish proper criteria for this diagnosis, it is suggested that the ulcer must exceed 2.5 cm. in diameter, it should be located within the first 5 cm. of the duodenum, and should be accurately measured and histologically studied either at surgical exploration, extirpation or autopsy. If the diagnosis is based on the roentgen examination or no histologic examination is made, a three-year clinical follow-up should be made in order to exclude a carcinoma of the duodenum.

Ordinary ulcers of the duodenum are said to range between 1 and 25 mm. in diameter, being most frequently between 4 and 10 mm. It is also emphasized that the mucosa of the superior portion of the duodenum is similar to that found in the pylorus of the stomach.

One roentgenogram; 1 photograph; 1 table.

HARRY HAUSER, M.D.
Cleveland City Hospital

Relation of Sustained Contraction of the Duodenum to Nausea and Vomiting. Frank K. Abbot, Marian Mack, and Stewart Wolf. *Gastroenterology* 20: 238-248, February 1952.

Transitory periods of sustained contraction of the duodenum (duodenal spasm) were investigated in 68 experiments on 61 human subjects, half of whom were healthy, while the remainder suffered from duodenal ulcer or other gastrointestinal disturbances. Simultaneous tracings were made from balloons within the gastric antrum and the second and third portion of the duodenum. Periods of transitory sustained duodenal contraction characteristically but not invariably accompanied nausea, however induced. Caloric vestibular stimulation by the introduction of water at 18° C. into the auditory canal for three to six minutes and stimulation by the introduction into the stomach or duodenum of 2 to 10 c.c. of syrup of ipecac were employed. Moreover, it was possible to produce such "spasms" by a variety of other noxious but not necessarily nauseating stimuli, including painful stimulation of the hand and head (hand in cold water and constricting steel band around head) and interviews dealing with emotionally charged topics. A consistent phenomenon associated with duodenal "spasm" was movement of the intestinal contents. Balloons proximal to the area of "spasm" moved back toward the stomach. Radiopaque sacs and barium sulfate suspension placed distal to the "spasm" moved forward. Duodenal "spasms" were invariably associated with hypomotility and hypotonia of the stomach, so that frequently the distal balloon was regurgitated into the stomach.

It is concluded that duodenal spasm is not essential to the sensory experience of nausea, but that, although it may occur independently of actual regurgitation from the stomach, it may well be part of the motor mechanism of vomiting.

Eight figures combining graphs and roentgenograms. HARRY HAUSER, M.D.
Cleveland City Hospital

Recurrent Gallstone Small Bowel Obstruction. Elmer Milch, F. L. Meudez, Jr., and Harry Murphy. *Arch. Surg.* 64: 847-850, June 1952.

Eight cases due to gallstones were found among 217

examples of complete small intestinal obstruction observed in the Buffalo General Hospital in a five-year period (1946-51). This cause of intestinal occlusion must be thought of in all elderly patients with no history of previous laparotomy. A clinical picture of obstruction with roentgen evidence of gas in the biliary tree is suggestive of the diagnosis. In some instances roentgen demonstration of an opaque density within the dilated loops of small bowel is possible. When no contraindications exist, the use of an oral contrast medium will often outline the enterocholecystic fistula.

The authors present the case of a 67-year-old woman with two separate episodes of small bowel obstruction due to gallstones. The biliary tree was visualized with air on both occasions. The patient had refused biliary surgery after the first attack. This is believed to be the sixth reported case of true recurrent intestinal obstruction due to a second gallstone not originally present in the intestinal tract.

Two roentgenograms; 1 drawing.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Chronic Perforating Carcinoma of the Colon. Clyde A. Stevenson and Arno W. Sommer. *South. M. J.* 45: 477-481, June 1952.

From 10 to 16 per cent of 500 consecutive cases of carcinoma of the colon showed gross evidence of perforation. These were studied in an attempt to determine the accuracy of the roentgen diagnosis of this complication. Absolute diagnostic criteria are a typical carcinomatous defect plus free gas in the abdomen, a fistulous tract, or a fistulous communication with some adjacent organ. Indirect signs of chronic perforation are a carcinomatous defect plus a longer than usual deformity, a palpable mass adjacent to the carcinoma, or fixation of the bowel at the site of the carcinoma. The most reliable sign is unusual length of the defect.

Of 80 cases with evidence of chronic perforating carcinoma of the colon, 20 per cent showed fistulous extension to an adjacent organ. In 40 cases without fistulous communications, the outstanding pathologic finding was a mass outside the plane of the bowel wall. In 22 per cent of this latter group the extrinsic mass did not compress the bowel wall, making the roentgenologic diagnosis inaccurate with regard to perforation. The average roentgenographic length of a non-perforated carcinoma was 3.86 cm. while in 52 cases of chronic perforation, the length of the defect averaged 7.5 cm. The extrinsic mass of chronic perforating carcinoma was found to contain gross carcinoma in approximately 75 per cent of cases.

In the presence of chronic perforation and extension of the extrinsic mass up or down the outside of the colon, the spur-like areas usually seen at the junction of normal and carcinomatous bowel may be obliterated, and the change from carcinoma defect to normal bowel outline is gradual. The change from carcinomatous mucosa to normal, however, is not altered by this extrinsic pressure. Segmental ulcerative disease or a granulomatous process is differentiated from a chronically perforated carcinoma by failure to find any of the signs of a carcinoma.

[See also a paper by these same authors in this issue of *RADIOLOGY*, p. 485.—Ed.]

Ten roentgenograms; 2 photographs.

W. A. NAFIS, M.D.
Jefferson Medical College

Chronic Ulcerative Colitis. Case Report in a Newborn Infant. Samuel L. Beranbaum and Robert J. Waldron. *Pediatrics* 9: 773-778, June 1952.

A case of ulcerative colitis in a newborn infant is reported. This is believed to be the earliest case on record with complete roentgenographic studies of the colon. The patient was admitted to the hospital at the age of twenty-one days, with a history of vomiting beginning three days after birth. The only positive physical findings were abdominal distention and some prominence of the superficial veins of the abdominal wall. A roentgenogram of the abdomen showed moderate gaseous distention of the intestines. A barium enema study revealed multiple irregularities of the mucosal pattern with numerous small ulcerations, which were attributed to ulcerative colitis. A barium meal showed tubularity throughout the colon, with absence of haustrations.

The consensus of surgical opinion was that the infant had a small-bowel obstruction, and a laparotomy was carried out. The wall of the terminal ileum, cecum, ascending colon, and part of the transverse colon was thick, extremely friable, and inflamed. Following a rather stormy convalescence, during which a transverse colostomy was performed, the patient's condition improved and when he was readmitted to the hospital at the age of eight months the only positive physical finding was the colostomy opening. Abdominal distention developed on the eighth day following closure of the colostomy, and in spite of all treatment the infant died three days later. Necropsy showed an acute ulcerative colitis and an acute ileitis.

Four roentgenograms; 1 photograph; 1 photomicrograph.

Volvulus of the Sigmoid Colon. Gilbert O. Dean and J. Warren Murry. *Ann. Surg.* 135: 830-838, June 1952.

An analysis of 21 cases of volvulus of the sigmoid colon is made. Fourteen patients were males and 7 females, with the age varying from four to eighty. The four-year-old child had been undergoing treatment for Hirschsprung's disease.

Six of the 21 patients were found to have moderately distended abdomens, with a history of recurring attacks associated with spontaneous relief. The symptomatology of chronic volvulus appeared to be so benign that most patients either failed to seek medical attention or were neglected until acute volvulus occurred. In only 3 patients in this series did severe intestinal obstruction fail to develop, requiring emergency procedures.

In 18 cases acute sigmoid volvulus developed, characterized by rapid distention, abdominal pain, rhythmic contractions of the twisted loops of sigmoid, and in some cases vomiting. Seventeen cases were diagnosed preoperatively. Roentgen studies showed the enormously dilated loop of bowel with its apex in the left or right upper abdomen. A barium enema study revealed the "corkscrew" defect at the rectum and sigmoid in some cases, and "ace of spades" or "bird beak" deformity in others.

Therapeutic procedures were carried out as follows: (a) Six cases were treated by elective resection and anastomosis several days after reduction of the volvulus and collapse of the sigmoid colon. (b) Eleven cases were treated by primary resection and anastomosis at the time of operation for early acute volvulus. (c) In 3 cases of far-advanced volvulus adequate surgical

therapy was impossible. (d) In 1 case simple operative derotation of the volvulus was accomplished.

The development of gangrene in the twisted loop of a sigmoid colon volvulus greatly decreases the chances of the patient's survival. Delayed treatment of acute volvulus of the sigmoid can result in death even in the absence of gangrenous bowel.

Six roentgenograms. FRANK T. MORAN, M.D.
Auburn, N. Y.

Abdominal Gas Cysts (Pneumatosis Cystoides Intestinorum Hominis). An Analysis with a Report of a Case and a Critical Review of the Literature. Leopold G. Koss. Arch. Path. 53: 523-549, June 1952.

The author discusses at great length, with a full review of the literature, the subject of abdominal gas cysts, or pneumatosis cystoides intestinorum, their pathogenesis, gross and microscopic appearance, and clinical course. He reports a classic case with necropsy findings.

It is concluded that the cysts represent a well defined morphological entity with characteristic pathologic findings and that wider knowledge of the x-ray picture and of the frequent occurrence of spontaneous pneumoperitoneum should aid in establishing a correct clinical diagnosis. The radiological findings are not described in detail but reference is made to numerous papers in which these are given (see, for example, Gazin *et al.*: Am. J. Surg. 77: 563, 1949, and Stiennon: Am. J. Dis. Child. 81: 651, 1951. Abst. in Radiology 54: 622, 1950, and 58: 607, 1952).

One roentgenogram; 3 photographs; 7 photomicrographs; 3 tables.

"Re-Formed Gall Bladder" with Stones Following Cholecystectomy Seventeen Years Ago. Harold J. Livingston and Saul F. Livingston. Arch. Int. Med. 89: 961-966, June 1952.

A case of "re-formed gallbladder" with stones following cholecystectomy seventeen years previously is reported. For eight years after the operation the patient was asymptomatic. She then began to experience vague pains in the right lower abdominal quadrant and mid back, which gradually became worse. Eleven years postoperatively she had a severe attack, the pain appearing first in the right lower abdominal quadrant and at times radiating to the back. A scout film of the abdomen was negative for calculi; intravenous pyelograms were normal. The patient again became asymptomatic. Four years later she began to have colicky pain, starting to the right of the umbilicus or directly over the lower angle of the scar in the right upper quadrant, radiating around to the back and sometime down to the right groin. Morphine was required for relief. Films of the abdomen, including the right upper quadrant and pancreatic region, revealed no evidence of calculi. The attacks became more severe and more or less continuous. A gastrointestinal series was normal; however, a cluster of faint shadows with calcific rims was seen about 1 inch to the right of the transverse process of the second lumbar vertebra. The biliary sac was not demonstrated on cholecystography. On numerous spot cone-down studies, the faintly calcific shadows of a faceted nature were again identified. At laparotomy, a sac-like structure was found in the region of the previous gallbladder bed, covered by and

adherent to the duodenum. This structure contained several calculi. It was removed, along with some black amorphous calculus-like material from the common duct, and the patient became asymptomatic.

A surgeon, when performing a cholecystectomy, should make every effort to ligate the cystic duct close to its junction with the common duct.

Two roentgenograms; 1 photomicrograph.

Defects in Right Diaphragm of Infants and Children with Herniation of Liver. Mark M. Ravitch and Jacob C. Handelsman. Arch. Surg. 64: 794-802, June 1952.

The authors present 5 cases in young children which do not come strictly within the definition of either diaphragmatic hernia or eventration. The abnormality in these cases consisted in an attenuation of a section of the diaphragm which is normally muscular. In each instance there was a central well defined defect in the right diaphragm ringed by normal muscle. The defects varied in size from 4 cm. in diameter to areas equal to half the right diaphragm. The authors state that the smaller the involved portion, the greater is its resemblance to a congenital diaphragmatic hernia. The normal muscle of the diaphragm acts as a ring, permitting the thin atonic portion to bulge into the thorax as a sac. Early operation is advocated for this type hernia as for the usual diaphragmatic hernia.

Radiographically each of these "hernias" appeared as a mass in the right thorax. Its superior margin was sharp and the inferior was not separable from the diaphragm. Movement of the mass coincident with diaphragmatic motion was observed fluoroscopically in some cases but not detectable in others. Postoperative follow-up showed a normally functioning diaphragm.

Reproduction of preoperative and postoperative roentgenograms are included for each of the cases.

Sixteen roentgenograms. DORIS E. PIPKIN, M.D.
University of Louisville

Is the Reflux of Bile into the Pancreatic Ducts a Normal or Abnormal Physiologic Process? N. Frederick Hicken and A. James McAllister. Am. J. Surg. 83: 781-786, June 1952.

This paper describes the cholangiographic findings in 100 patients in whom reflux of opaque material into the pancreatic ducts was observed. The purpose of the study was to determine the conditions leading to the reflux of bile into the pancreatic ducts and the significance thereof. The existing intraductal pressure was first determined, iodopyracet was then injected at the same pressure, and roentgenograms were obtained. Whenever the contrast mixture was seen to enter the pancreatic ducts, biopsies were taken from the uncinate process of the pancreas. Many of the cholangiograms were obtained at the operating table, many postoperatively, and some both operatively and postoperatively.

In 30 cases the choledochus and duct of Wirsung fused to form a common channel before entering the duodenum; in 57 cases the two ductal systems emptied directly into the duodenum through a single stoma, and in the remainder there were two separate duodenal orifices. It was noted that intraductal calculi did not produce complete obstruction to the opaque material in any of the cases. The intraductal pressures were normal in these instances. Postoperative intraductal pressures showed no change. In every instance the intra-

ductal pressures were below 150 mm. of water and the contrast fluid was seen to flow around the stones into the duodenum. The regurgitation of bile into the pancreatic ducts occurs not because of increased intraductal pressure but because the pancreatic ducts stay open.

Pancreatic biopsies revealed pancreatitis in only 3 of the 100 cases studied. Apparently bile can enter the pancreatic ducts without producing inflammatory changes in the pancreas and may be regarded as a normal physiologic process.

Eight roentgenograms; 1 drawing.

PAUL W. ROMAN, M.D.
Baltimore, Md.

Vitamin Studies in Middle-Aged and Old Individuals. VII. Roentgenological Studies of the Gastrointestinal Tract in Patients with Hypovitaminemia B₁. R. W. Maxwell, M. Chieffi, and J. E. Kirk. *Gastroenterology* 20: 309-314, February 1952.

Because some reports in the literature indicate that normal individuals who show no laboratory evidence of a "deficiency state" exhibit roentgen changes in the small intestine usually attributed to such a condition, the authors examined 20 middle-aged and elderly individuals with normal blood thiamine levels and 20 patients with blood thiamine concentrations below 2.4 micrograms per cent. The latter group was re-examined three months later when the blood thiamine level had been returned to normal by oral administration of thiamine hydrochloride, at which time most of the clinical signs had disappeared. No significant radiological abnormalities were observed in either of the groups examined.

These findings do not exclude the possibility that a more severe grade of thiamine deficiency may be accompanied by radiological evidence of gastrointestinal abnormality.

One graph; 1 table.

HARRY HAUSER, M.D.
Cleveland City Hospital

THE MUSCULOSKELETAL SYSTEM

The Radiological Features of Rheumatoid Arthritis. D. E. Fletcher and K. A. Rowley. *Brit. J. Radiol.* 25: 282-295, June 1952.

Roentgen examination may not always be relied upon in the early diagnosis of rheumatoid arthritis. In a series of 364 joints examined by clinical and radiological means at the same time there was agreement that some abnormality was present in 46 per cent. In 49 per cent pathological changes were found by clinical examination but not by roentgen ray, and in 5 per cent radiological evidence of disease was discovered in the absence of clinical symptoms. Most of the examinations were done by conventional roentgenological methods, a few by magnification techniques.

Two hundred cases of known rheumatoid arthritis were studied in detail. The joints of the hands were examined in practically all cases, the feet in 40 per cent, and other joints occasionally. Serial films were made in some instances. More than 40 per cent of the cases were of less than one year duration, while in 20 per cent symptoms had been present for five years or longer. There is a latent period in which no roentgen evidence is seen. After three months of symptoms clinically, 65 per cent of the series showed roentgen changes and after six months 80 per cent.

The findings in the order of frequency are: bony erosions 76 per cent; uniform diminution of joint space 75 per cent; osteoporosis 64.5 per cent; eccentric diminution of joint space 21 per cent; subluxation 21 per cent; widening of joint space 6 per cent; bony ankylosis 5 per cent; and no abnormality 8.5 per cent. Evidence of osteoarthritic changes in addition to rheumatoid arthritis was found in a considerable number of cases: osteophytes in 36 per cent, periarticular ossicles in 20 per cent, and sclerosis in 5 per cent. Changes were most common in the interphalangeal and metacarpophalangeal joints of the first three fingers and in the metatarsophalangeal joints of the middle and little toes.

As early bone erosions are minute, they may be seen only with the aid of a magnifying glass or magnification techniques. When they are present, there are thinning of the cortex and roughening of the outer surface. These changes were present in 28 per cent of the cases. Deep-pocketed erosions were seen in 49 per cent. In 23 per cent erosion of bone below a normal cortex was observed.

Reduction in joint space is sometimes difficult to evaluate, as the radiographs may have to be made in partial flexion. Careful technic is required to obviate this, particularly the use of tangential and oblique views.

Subluxation and ankylosis occur in late cases.

Osteoporosis is also difficult to evaluate. A simple method of control is to radiograph simultaneously a bone encased in paraffin for comparison.

In general, even though clinical symptoms of rheumatoid arthritis subside, changes seen on the radiograph tend to progress. There is occasionally temporary restoration of bone density, with healing of erosions.

Seventeen figures, including 20 roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Painful Periarticular Calcifications at the Wrist and Elbow: Diagnosis and Treatment. Irving I. Cowan and Joseph R. Stone. *J.A.M.A.* 149: 530-533, June 7, 1952.

Of the many reports on periarticular calcific deposition, few have been concerned with the wrist and elbow joint. The authors report a series of 11 such cases.

The history of these cases is quite typical, with an acute onset of muscle spasm, limitation of motion, local heat, and edema. About the wrist the swelling is confined to the flexor surface; in the elbow the swelling involves the lateral and posterior aspects and the roentgenogram reveals soft-tissue calcification adjacent to the lateral condyle of the humerus. Tenderness is sharply localized and exquisite in character, is confined to an area directly over the calcification, and corresponds to the calcific area demonstrated roentgenologically.

In the series of cases recorded here, trauma and occupational factors were notable for their absence. Women outnumbered men 5 to 1. The several theories of etiology and pathogenesis leave the explanation of the process in some doubt.

Differential diagnosis includes a long list of entities, most of which are excluded without difficulty. In myositis ossificans and calcified hematoma there is likely to be a history of trauma. In the former the calcifications are linear in distribution and follow the

planes of the muscle fibers and fascia. In hypervitaminosis D there is a history of prolonged ingestion of the vitamin. The lesions of hyperparathyroidism are multiple, usually involving the long bones, and other evidences of the disease are obtainable. Tuberculosis causes destructive lesions of the bone and parosseous abscesses. Roentgenographically the conditions calling for differentiation are fractures and an extra sesamoid bone. In the case of a fracture, the fragment of bone is usually homogeneous in character, in contrast to the irregular or spotty calcification in the extra osseous tissues. Also, a defect can usually be demonstrated in the adjacent bone. A sesamoid is smooth in outline and contains definite bone trabeculation, while the calcific nodule usually has a homogeneous density and may be slightly irregular or fragmented, and never contains trabeculations.

Roentgen examination should include not only the routine anteroposterior and lateral views of the part but also special views. Roentgen studies of the elbow should include internal and external oblique views with the joint extended. In the wrist, one should obtain not only internal and external oblique views but also radiographs made with the hand in ulnar and radial deviation while the wrist is in the postero-anterior position. The radiographic studies should also include at least two exposures with lower kilovoltage than is ordinarily used for bone, in order to demonstrate soft-tissue detail and thereby reveal even the smallest or minimal calcific shadows in the soft parts adjacent to the joints.

Many investigators have reported on the value of x-ray therapy in periarthritic calcifications at the wrist and elbow, either alone or with supplemental symptomatic treatment. Leukocytic breakdown and analgesia secondary to irradiation effects on nerve fibers may explain the favorable response.

All of the authors' patients showed partial or complete disappearance of the calcification following irradiation with 450 to 900 r (in air) given in doses of 150 to 200 r daily in the acute and on alternate days in the subacute cases (200 kv.p., 50 cm. T.S.D., 0.25 mm. Cu filter, 20 ma., h.v.l. 0.85 mm. Cu). Most patients showed a good immediate response, with occasional transient exacerbation after the first two treatments. No supplemental measures were used, and no recurrence of symptoms was observed.

Three roentgenograms; 1 table.

EDWARD E. TENNANT, M.D.
Jacksonville, N. C.

Osteochondrosis Dissecans in Two Brothers. The Pre- and Developed State. Hans Novotny. *Acta radiol.* 37: 493-497, May 1952.

The author presents a report of the development of osteochondrosis dissecans in two brothers. The elder was found to have typical osteochondrosis dissecans of the lateral femoral condyle at the age of twelve, with no displacement of the separated body. In the younger brother a less well developed focus of osteochondrosis dissecans was discovered in the right medial femoral condyle at the age of eleven and one-half. Roentgen examination of his other knee revealed irregularity of the medial femoral condyle. The author believes that this irregularity represented recent union of accessory osseous nuclei with the epiphysis and offers these cases in support of Ribbing's thesis that osteochondrosis dissecans develops from these accessory osseous nuclei.

Both patients were treated with immobilization in plaster, with healing in six months for the elder and in three months for the younger. It is concluded that children in this age group who present minimal early symptoms and roentgen findings should be treated by plaster immobilization. The period of morbidity will be shortened by this approach.

Eleven roentgenograms.

ALVIN J. GREENBERG, M.D.
Mt. Sinai Hospital of Cleveland

Spondylitis Chondromalacica. E. Günsel. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 76: 761-764, June 1952. (In German)

Günsel designates as "spondylitis chondromalacica" an acute disease of the vertebral disks, involving several vertebral segments, following paravertebral novocain block of the sympathetic chain. Three cases have been previously reported (Günsel: *Fortschr. a. d. Geb. d. Röntgenstrahlen* 74: 522, 1951. *Abst. in Radiology* 58: 616, 1952). In a fourth case, presented here, the course was characteristic. Two days after the nerve-blocking procedure a severe clinical condition developed, with temperature up to 39° C., sharp intense backache, nuchal rigidity resembling a meningeal reaction, abdominal symptoms with tympanites, peritoneal signs, etc. Regression of the symptoms started in ten days, but the condition became tolerable only in three months. Characteristic roentgen signs could be visualized only on the fifty-seventh day, after the acute clinical symptoms had subsided. The 3rd, 4th, and 5th lumbar intervertebral disks were involved, with corresponding damage and irregular destruction of the cover plates of the affected vertebral bodies. In the three earlier cases, three, seven, and thirteen disks, respectively, were involved. The nerve block was performed in all cases on men, for endarteritis obliterans of the legs.

Two roentgenograms. LEWIS L. HAAS, M.D.
Chicago, Ill.

Osteitis Condensans Ilii. The Relationship to Juvenile Epiphysitis. Walter H. Ude. *Minnesota Med.* 35: 541-543, June 1952.

The theory that osteitis condensans ilii is the result of juvenile epiphysitis of the sacroiliac joints is held by the author to be supported by observation of 36 cases in which both Scheuermann's disease and condensing iliitis were present. [His first publication on this subject was probably overlooked by most radiologists (*Journal-Lancet* 70: 81, 1950).] The fact that the condition has been seen in a few males and in an unmarried girl of eighteen indicates that pregnancy is not the only factor in its development. The author holds that all cases have epiphysitis as the underlying mechanism but that pregnancy may well be a contributing factor. He believes it is the horizontal position of the sacrum in the gynecoid type of pelvis which makes it more likely to show the dense (localized) bone reaction seen in females. In the android pelvis, the iliitis is more diffuse and less likely to be noticed.

Degenerative changes have been observed in the sacroiliac joints in association with osteitis condensans ilii, contrary to the opinions of some who have stated that the joints are not involved. [It should be an interesting study, when one of the conditions is found, to look for the other.—Z.F.E.]

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Fractures of the Spine During Insulin Shock Therapy. Chalmers S. Pool and Isadore Meschan. *Arch. Neurol. & Psychiat.* 67: 797-807, June 1952.

A study was made of the thoracic spines of 166 male psychotic patients treated with insulin shock, 99 without and 67 with combined electric shock. Seventy-eight of the total had received no previous shock therapy; 88 had previous electric shock treatments. Of the 78 with no previous shock therapy, 46 were treated with insulin shock alone and 32 with electric shock superimposed on insulin coma.

An incidence of 18 per cent of spinal fractures was found, which is about one-half the incidence of spinal fracture with electric shock.

In both insulin shock and electric shock a significant predisposing factor to fracture was found to be an anterior narrowing of one or more of the vertebral bodies prior to therapy. In the survey conducted by the authors, 74 of the patients showed narrowness of one or more vertebral bodies on the control film, and 19 of these sustained compression injuries of the spine. Of 89 patients whose thoracic vertebrae were considered to be normal roentgenographically, only 12 sustained fractures. It is interesting to note that it is usually not the narrowed vertebra that undergoes the compression.

Fractures occurred less frequently in insulin-resistant patients and with almost equal frequency in patients with and without recorded grand mal convulsions during insulin coma.

Two roentgenograms; 1 table.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Multiple Slipped Femoral Epiphyses. Case Report. Richard H. Eppright and Bedford F. Boylston. *Surgery* 31: 928-932, June 1952.

A case is recorded of a 14-year-old Negro boy who suffered complete displacement of both the upper femoral epiphysis on the right and the lower epiphysis on the left within a period of two years. There was also minimal displacement (less than 2 cm.) of the left capital femoral epiphysis. No discrepancy in the leg length occurred. Seven months after the displacement of the upper femoral epiphysis, the patient walked without a limp, and there was no evidence of aseptic necrosis.

The case is interesting in that the slipped lower femoral epiphysis occurred at the age of twelve years, with possibly adequate trauma to explain an acute slip. Though the roentgenograms did not demonstrate the triangular metaphyseal fragment so commonly seen with this injury, particularly of the lower femur, one must assume that this was probably a traumatic slip. Whether there was an underlying epiphyseal defect one can only speculate.

Ten roentgenograms.

Vitamin A Intoxication. Report of a Case. Gertrud C. Meyersbach, Joseph Hanelin, and Robert J. Joplin. *New England J. Med.* 246: 978-980, June 19, 1952.

Another case of vitamin A intoxication is added to the literature, with a discussion of the roentgenographic aspects and the differential diagnosis. Since prolonged dosage of the vitamin is a necessary prerequisite, it follows that the condition is not seen in very young infants, but usually in children of a year and a half to two years, in direct contrast to infantile cortical hyperostosis with which it is most likely to be confused.

Roentgenographically the appearance of hyperostosis is the cardinal sign, slightly less marked than in infantile cortical hyperostosis. The bones involved in the two conditions are somewhat different, with the mandible as the best dividing line so far. It is invariably involved in infantile cortical hyperostosis but has shown no changes in vitamin A intoxication. In the latter the ulnas and metatarsals have been uniformly involved and only 1 out of 22 reported cases has shown any metacarpal changes.

In vitamin A intoxication the skin is dry, scaly, and thickened and the hair is sparse and coarse. No fever, leukocytosis or pleural effusion is seen as in infantile cortical hyperostosis.

In the reported case withdrawal of vitamin A resulted in immediate clinical improvement with gradual absorption of the thickened periosteal new bone over a period of eleven months.

Seven roentgenograms (poorly reproduced).

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE BLOOD VESSELS

Aneurysm of the Ascending Aorta. J. E. Miller. *South. M. J.* 45: 503-508, June 1952.

Many aneurysms of the ascending aorta cannot be diagnosed by ordinary radiologic measures because of inadequate visualization. Angiocardiography is usually required to outline the dilatation unless sufficient calcium is present in the walls of the aneurysm to be seen on the plain films. The entire root of the aorta is within the cardiac silhouette, and is not seen in any projection. The portion of the ascending aorta first seen in the postero-anterior or left anterior oblique projection is five or six cm. above the aortic valves.

Prominence of the ascending aorta, detectable in both postero-anterior and left anterior oblique views is frequently seen in older individuals and is due to elongation and tortuosity of the aorta, and not necessarily to aneurysm or aortitis. In younger persons, this finding is of greater significance in diagnosing aneurysm. Various types of aneurysmal dilatations of the ascending portion of the aortic arch are discussed, and the value of angiocardiography in demonstrating the aneurysms is shown. Aneurysms due to syphilis, coarctation, Marfan's syndrome, aortic insufficiency, and saccular aneurysm of a sinus of Valsalva are included in the discussion.

Twelve roentgenograms. W. A. NAFIS, M.D.
Jefferson Medical College

Abdominal Aortic Aneurysm. K. F. MacEwen. *J. Canad. A. Radiologists* 3: 42-46, June 1952.

Thirteen cases of abdominal aortic aneurysm are reported, of which 12 are attributed to arteriosclerosis. One was found at autopsy to be congenital in origin. Five of the arteriosclerotic aneurysms were proved to be so at autopsy, 6 showed calcification of the abdominal aorta on roentgen examination, and the twelfth patient had a negative Wassermann test but no x-ray examination. The pulsating mass in this case was therefore presumed to be arteriosclerotic in nature. The congenital aneurysm occurred in a 24-year-old male. The average age of the remaining patients was 69.5 years. All of these aneurysms were below the renal arteries. None of them showed vertebral erosion.

The author points out that syphilitic aortitis is a dis-

ease of younger people (average age 46.4 years) and that arteriosclerotic aortitis is a disease of older people. Almost all aortic aneurysms above the renal arteries are syphilitic, while 60 per cent of those below the renal arteries are arteriosclerotic. Pain is the first subjective symptom and is a bad prognostic sign, since 88 per cent of patients are dead within one year of the onset of the pain.

Characteristic evidences of aneurysm on roentgen examination are erosions of vertebral bodies, calcification in the walls of the aorta, and displacement of loops of bowel or of the kidneys.

Three roentgenograms.

RICHARD F. McCURE, M.D.
Camp Pendleton, Calif.

OBSTETRICS AND GYNECOLOGY

Roentgen Fetal Cephalometry. J. Sheridan Bell and Arthur L. Rawlings. *Am. J. Obst. & Gynec.* **63**: 1371-1373, June 1952.

The authors describe a method of fetal cephalometry in which a metal ball is used to obtain the distortion factor. A nomogram is presented whereby the true measurement of the fetal head may be calculated.

Two roentgenograms; 1 photograph.

JOHN M. KOHL, M.D.
Jefferson Medical College

Soft-Tissue Radiography of the Placenta. Carl F. Qvist. *Acta radiol.* **37**: 510-518, June 1952.

The author reviews most of the methods which have been described for placental visualization and reports his own findings in relation to soft-tissue radiography of the placenta.

Because of the ease of carrying out this examination, it is recommended that patients in whom placenta praevia is suspected be radiographed by the soft-tissue technic. When the placenta is visualized in the upper dorsal or upper ventral segment, placenta praevia is not present (virtually the entire placenta should be visible above the level of the iliac crest). On the other hand, when the placenta is either not visualized at all or when it is located in the lower uterine segments, further diagnostic procedures are indicated to exclude or prove the presence of placenta praevia.

The author was able to visualize the placenta in the upper ventral or dorsal segment of the uterus in 46 of 52 cases and in the lower ventral segment in 4 cases. Only 4 of the group of 52 patients had been referred because of vaginal bleeding. The placental shadow on the average measured 5.6 cm. in thickness (3.0 to 9.5 cm. range). The length of the shadow is, as a rule, about 20 to 25 cm. A lateral film is obtained, supplemented occasionally by oblique views.

[Technical factors are not described by the author, but it has been the abstractor's experience that the kilovoltage should be in the range of 45 to 60, usually not over 55.—R.A.E.]

Three roentgenograms.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Placental and Pelvic Angiography by Retrograde Percutaneous Injection of the Femoral Artery: A Preliminary Report. David Sutton. *Brit. J. Radiol.* **25**: 320-325, June 1952.

By retrograde injection of the femoral artery, the

author has found it possible to demonstrate the circulation in the placenta and in pelvic tumors. The needle is introduced into the femoral artery in a retrograde direction. Both femoral arteries are occluded by a sphygmomanometer cuff, and the medium is injected forcibly. Diodone has proved to give satisfactory visualization of the vessels. Films are made just before the end of the injection and three and four seconds after its completion.

The author has investigated 3 cases of suspected placenta praevia by this procedure, 2 of which are illustrated here. He also reports a tumor of the ilium similarly studied.

Seven roentgenograms; 1 photomicrograph.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

THE GENITOURINARY SYSTEM

Bedside Urological X-Ray Examination of the Severely Injured Patient. Lazarus A. Orkin. *Surg., Gynec. & Obst.* **94**: 693-702, June 1952.

There is no clinical correlation between the intensity of traumatism and the gravity of urinary tract injuries. It is therefore important that urologic roentgenography be done as promptly as possible. Because of the reluctance to disturb a very sick patient and because of the inconvenience of doing a bedside urologic study, such examinations are usually deferred until the patient can be moved. The author has found, however, that invaluable information is obtained by immediate bedside studies even in the presence of severe symptoms.

Thirty-eight severely injured patients were studied. Of these, 8 were in clinical shock, with blood pressure between 68 and 76 mm. of mercury systolic at the time the pyelograms were obtained. While it is generally agreed that the procedure should be deferred until recovery from shock, none the less in a patient who is failing to rally, an accurate diagnosis may be of more importance than cautious observation. Excellent pyelograms were obtained in these 8 patients, and there were no ill effects.

The author employs a grid and obtains films of useful quality. A catheter is passed to the bladder and clamped. Excretory urography is performed. Late films at sixty and possibly ninety minutes are taken of the bladder. If the cystogram is unsatisfactory, the catheter is unclamped and retrograde cystography is done. Retrograde kidney studies are done, as necessary.

The procedure is also valuable in evaluating other surgical conditions which may be found in an injured patient.

Not infrequently, in patients with fractures of the lower extremities who are immobilized by casts or who are in traction, urological complications may develop. Under these circumstances, valuable studies may be made at the bedside.

Twelve roentgenograms; 1 photograph.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Excretory Urography in the Diagnosis of Ureteropelvic Obstruction. William L. McLaughlin and John P. Bowler. *J. Urol.* **67**: 1012-1016, June 1952.

Retrograde pyelography may produce pain, shock, nausea and vomiting, hematuria, and may even acti-

vate a previously latent infection of the urinary tract. A modification of the usual technic of excretory urography which makes possible the diagnosis of ureteropelvic obstruction without resorting to retrograde studies is presented.

Urine containing the contrast medium, since it has a high specific gravity, will gravitate to the most dependent part of the urinary tract. The films should be developed and interpreted as the series progresses. The "delayed film," is taken at an interval later than usual in the series—at forty-five or sixty minutes or even later—in the supine position. If there appears to be good delineation of the kidney, the patient is then placed prone on the x-ray table and, after ten minutes of complete rest in this position, a postero-anterior view is taken. The patient is then placed supine and the table is tilted to a vertical position. After ten minutes an erect view is obtained. In patients with ureteropelvic obstructions who are lying supine, the greater part of the contrast medium-laden urine fills the upper portion of the kidney. In the prone and erect positions the urine gravitates into the pelvis, and the area of the ureteropelvic junction may be well outlined.

Thirty-three cases having congenital ureteropelvic obstruction confirmed at operation are reported. Excretory urography was sufficient for a diagnosis in 29 cases. Only in the remaining 4 cases was retrograde pyelography thought to play an essential role in establishing the diagnosis.

Seven roentgenograms; 2 diagrams.

RICHARD F. McCLURE, M.D.
Camp Pendleton, Calif.

Ureteral Complications and Alterations of Ureteral Tonus in Regional Ileitis. Milton H. Redish. *New England J. Med.* 246: 993-996, June 26, 1952.

The occurrence of extravascular urinary tract complications of regional ileitis has not been adequately appreciated. The tendency to fistula formation, often complicated by abscess, is well known and has been well documented. Little has been said, however, concerning ureteral obstruction as a complication of ileitis.

The authors present 6 cases in which abnormal ureteral findings complicated ileitis. The abnormal findings, dilatation and displacement, may be organic in nature. The ureter becomes involved in the retroperitoneal spread of the inflammation and hydronephrosis may result if the lesion persists. On the other hand, the process may be speedily reversible, suggesting that it is reflex in nature.

The right ureter is usually involved, but in one of the cases described bilateral ureteral dilatation was present, more marked on the right.

Three roentgenograms. FRANK T. MORAN, M.D.
Auburn, N. Y.

A Method of Topographic Urethrocytography in Women. Björn E. W. Nordenström. *Acta radiol.* 37: 503-509, June 1952.

For the accurate estimation of the topography of the bladder and urethra, lateral and anteroposterior urethrocytograms are of fundamental importance. For lateral urethrography, considerable opacity of the contrast medium is necessary. A suspension of barium in sterile water has given the best results. With this material, it is possible to obtain lateral films of the female urethra during micturition.

The bladder is emptied and the medium is injected slowly through a catheter until the patient feels a desire to void. In cases of neurogenic disturbance of the sensitivity of the bladder, about 200 c.c. may be injected. The catheter is removed. A small indicator is held immediately above the external meatus by adhesive tape; a second indicator, marked in centimeters, is placed in a sagittal plane below the external meatus for direct measurements on the lateral films.

A nylon bag is tied between the thighs of the patient. Radiographs are obtained in anteroposterior and lateral projections with the patient standing with legs apart. Exposures are made in rest, micturition, and holding. If there is difficulty in voiding in a standing position, it is often possible to obtain films with the patient sitting. If she is unable to void, views may be obtained during straining.

After the investigation, the bladder is thoroughly washed out with sterile water at body temperature.

The author has seen no complication as the result of barium injection into the urinary bladder.

Three roentgenograms; 1 photograph.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Cystitis Emphysematosa. Case Report with Clinical Diagnosis and Review of the Literature. W. A. Milner, W. B. Garlick, and C. Mamonas. *New England J. Med.* 246: 902-905, June 5, 1952.

Cystitis emphysematosa has been defined as an "emphysematous condition of the bladder wall associated with cystitis and hemorrhage." The majority of cases have been observed at autopsy. Approximately 50 cases have been recorded in the literature, in only 13 of which was the diagnosis made antemortem.

The authors report a case of cystitis emphysematosa in a 64-year-old man, with clinical diagnosis and survival. This is the sixth case diagnosed by the radiolucent ring about the bladder wall in the excretory urogram. According to Kerr and Gillies (*The Urinary Tract: A Handbook of Roentgen Diagnosis*, Chicago, Year Book Publishers, 1944), the ring is absolutely pathognomonic of cystitis emphysematosa.

Three roentgenograms.

The Sequelae of Prostatic Surgery. M. Leopold Brodny and Samuel A. Robins. *J. Urol.* 67: 962-973, June 1952.

The findings of urethrocytography supplement and complement instrumental examination in the appraisal of the end-results of prostatic surgery. The examination is easily performed and is free from complications. Patients more readily submit to urethrographic check-up than to cystoscopy. The topographic alterations produced by prostatectomy and the involution of the prostatic cavity can be accurately and progressively recorded, and the disturbed function can often be interpreted on an anatomic physiologic basis.

Points to be considered in interpreting the post-operative urethrocytogram are as follows: (1) Changes in the bladder: With normal involution the bladder contour becomes smooth, the shape changes from a downward convexity to a downward concavity, and the base descends to the upper border of the symphysis pubis. (2) The status of the prostatic cavity: This is determined by the length, width, and deformities of the supracolicular urethra as well as its relationship

to the bladder base. (3) The configuration of the *perumontanum* and *vaso-deferential* reflux. (4) The *infracollicular prostatic urethra* and the *membranous urethra* should be unchanged from the preoperative state. (5) Changes in the *bulbous and penile urethra* from the preoperative state must be considered a result of surgery or secondary to a complication.

Urethrographic topography following prostatectomy is dependent upon many factors. Size of the prostate has a direct influence. Involution of the cavity is slower after removal of a fibrotic or calcified gland. Involution is more rapid following open operation than after transurethral resection. Shortly after surgery, the cavity appears relaxed, funnel-shaped, and irregular in outline. In the final stage of involution the cavity is spindle-shaped, with a slight dilatation in the middle third.

Periurethral abscess occurs most frequently after transurethral resection, and it is often demonstrated by urethrography when other diagnostic methods fail. In postoperative infection, urethrography often reveals atonicity and even absence of contraction in the region of the internal sphincter, the area appearing as an almost straight, undifferentiated tube. Excessive scarification in the cavity and calcification give a similar picture. Carcinoma of the prostatic bed prevents involution and produces a bizarre urethrogram. Residual prostatic tissue is an important cause of prolonged morbidity. The mechanical obstructions produced by hypertrophy of the interureteric ridge, the trigone, and the vesical neck are readily diagnosed by urethrography.

Sixteen roentgenograms; 4 drawings; 2 tables.

RICHARD F. McCLURE, M.D.
Camp Pendleton, Calif.

THE ADRENALS

Pheochromocytoma: Diagnosis and Treatment.

George F. Cahill. *J. Urol.* 67: 779-786, June 1952.

Pheochromocytoma should always be suspected in any hypertensive patient having either vasomotor attacks or hypermetabolism or both. The symptoms and signs depend principally upon the secretion by the tumor of epinephrine and/or norepinephrine. The tumors occur most frequently in adult females. They may be single or multiple. Multiple tumors occur in 10 per cent of the cases. The most common location is in the adrenal medulla, though the tumor may be found in the retroperitoneal ganglia or rarely in the thorax. Cutaneous neurofibromatosis has been associated in 5 per cent of cases. Malignant change in the tumor is reported in 9 per cent of the patients, most of whom did not have hypertension. The paroxysmal attacks are associated with anxiety and headache followed by precordial and epigastric distress. Most patients have palpitation, coldness and blanching of the extremities, some shortness of breath, and nausea or vomiting. In all cases profuse sweating occurs with cessation of the attack. Associated with the attack is elevation of systolic and diastolic blood pressures, hypermetabolism and often elevation of blood sugar with glycosuria.

Intravenous injection of histamine may be used as a provocative test for the tumor. Mecholyl also serves as a provocative drug, but it has more side reactions than histamine. Tetraethyl ammonium bromide has been considered less reliable as a provocative drug than histamine. The antagonist benzodioxane injected intravenously, 0.25 mg. per kilo of body weight, has a

predominantly depressor action in cases of hypertension with pheochromocytoma. In hypertension from other causes, benzodioxane has a predominantly pressor effect.

On x-ray examination a large tumor may show as a shadow in the plain film of the abdomen. The tumor may occasionally contain calcium. The pyelogram may show displacement of the kidney downward and flattening of its upper pole. Perirenal insufflation of air may outline the tumor when it is within the adrenal. Failure of air to infiltrate the fascial planes near the aorta may indicate the presence of a tumor in that region. Aortography may be of localizing value.

Treatment of pheochromocytoma is surgical removal. If the tumor is to be manipulated before complete severance of the blood vessels is carried out, a sympathicolytic drug such as Dibenamine or Regitine should be administered in order to avoid the marked hypertensive rise which follows release of the hormones into the circulation. Following removal of the tumor, sustaining hormones such as norepinephrine are required to combat hypotension and circulatory collapse.

RICHARD F. McCLURE, M.D.
Camp Pendleton, Calif.

TECHNIC; CONTRAST MEDIA

Pneumoretroperitoneum. Technique and Results.

Stig Fagerberg. *Acta radiol.* 37: 519-530, June 1952.

The author presents the technic and results of air injection in 18 patients, for visualization of the retroperitoneal space. Oxygen is used ordinarily, the usual amount for adults being 900 to 1,200 c.c. injected over a fifteen- to twenty-minute period. For children the amount is smaller—100 c.c. in an infant of three to four months. There were 5 children in the present series, from four months to fifteen years of age.

In 15 of the 18 patients the findings were entirely normal. Reports of the 3 remaining cases are included. The author considers the procedure the best means available for diagnosing suprarenal disease roentgenologically. It is also "a good complement both to the ordinary types of renal investigations and to more indirect studies of the retroperitoneal space."

Ten roentgenograms; 2 photographs; 2 drawings.

Tomography in Conjunction with Pneumoretroperitoneum. F. von Moos. *Schweiz. med. Wchnschr.* 82: 629-632, June 14, 1952. (In German)

The author describes the method of pneumoretroperitoneography which is in use at present in the St. Gallen Kanton Hospital, Switzerland. The insufflation technic is that of Ruiz Rivas (*Am. J. Roentgenol.* 64: 723, 1950. *Abst. in Radiology* 57: 618, 1951) and de Gennes *et al.* (*J. de radiol. et d'électrol.* 31: 340, 1950). Under local anesthesia, 900 to 1,200 c.c. of oxygen are introduced within ten to twelve minutes into the pre-sacral space. Films are taken fifteen to thirty minutes later. Frontal laminagrams are obtained in all cases and lateral ones in many. Effervescent powders are given by mouth in order to distend the stomach. The kidneys, adrenals, spleen, aorta, vena cava, and the pancreas are demonstrable.

The side effects are said to be minimal and complications are denied. The oxygen is resorbed in twenty-four to thirty-six hours.

[A serious typographical error seems to have occurred

in this publication: The anesthesia needle is described as having to be introduced into the *retrosacral* tissues. This should probably read *pre-sacral* tissues.—G.S.S.] Seven tomograms with accompanying drawings.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Transabdominal Cholangiography. R. Franklin Carter and George M. Saypol. *J.A.M.A.* 148: 253-255, Jan. 26, 1952.

The authors demonstrate the feasibility of opacification of the intrahepatic biliary tree in obstructive jaundice where there is no accessible patent extrahepatic biliary duct proximal to the obstruction. A needle is passed blindly through the liver substance until a free flow of bile is obtained. Contrast material is then injected. This has been done at laparotomy and in one case, recorded here, through the abdominal wall, with resultant satisfactory cholangiograms. [The risks of the procedure are not adequately presented to warrant recommendation of its widespread use.—M.M.F.]

Eight illustrations, including 3 roentgenograms.

M. M. FIGLEY, M.D.
University of Michigan

A Preliminary Evaluation of a New Cholecystographic Medium "Telepaque." Robert M. Lowman, Howard W. Stanley, Theodore S. Evans, and John C. Mendillo. *Gastroenterology* 21: 254-262, June 1952.

A comparison of Telepaque and Priodax was made in 100 patients who received the two compounds at different times. The following advantages of Telepaque were noted: (1) increased density of the gallbladder shadow; (2) demonstration of a functioning gallbladder in a higher percentage of cases; (3) fewer side reactions; (4) increased incidence of visualization of duct shadows; (5) adequate response to the fatty meal. The higher iodine content of Telepaque accounts for (1) and (2). Alteration of the phenyl ring may account for (3). The explanation for (4) and (5) may be that Telepaque is less sympathicomimetic than Priodax, thus improving the emptying ability of the gallbladder.

One minor disadvantage of the new compound is the higher incidence of residual opaque material in the colon, which sometimes overlies portions of the gallbladder shadow. No instance in this series was encountered, however, in which Telepaque obscured gallstones.

Numerous comparisons of these two media have appeared in the recent literature (see, for example Morgan and Stewart. *Radiology* 58: 231, 1952; Everett and Rigler. *Radiology* 58: 524, 1952).

Ten roentgenograms; 1 drawing; 1 table.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

Hepatosplenography: Results Obtained with a New Contrast Medium. J. Camerman. *J. belge de radiol.* 35: 512-517, 1952. (In French)

The danger of using thorotrast for contrast visualization of the liver and spleen has been cited by numerous authors. In 1938, Degkwitz and Beckermann introduced ethyl tri-iodostearate which seemed to show promise. During the Second World War and post-war years this product has not been manufactured. However, a similar product, ethyl di-iodostearate, has been presented by the Belgian Chemical Union under

the name of Angiopac (see Masy: *Acta radiol.* 34: 350, 1950. *Abst. in Radiology* 57: 617, 1951). The suspended particles measure 2μ in diameter. This substance affords good contrast for angiography and causes opacification of the liver and spleen. Dosage of 0.5 to 0.75 c.c. per kilogram of body weight provides good visualization of the spleen, opacity being noted from fifteen minutes to five hours after injection, with maximum contrast at one to three hours. In rare cases the spleen is faintly visible after twenty-four hours, never after forty-eight to seventy-two hours.

The liver and lymph nodes have not been opacified with the above dosage, but in animals a dosage of 2.0 c.c. per kilogram makes such visualization possible.

Minor complications such as chilly sensations, cyanosis, and headache have been noted from one-half to one hour after injection. These resolved spontaneously or after injection of adrenalin. No untoward effects have been noted after carotid injection, even in arteriosclerotic patients. Patients sensitive to iodine, those in poor general condition, and those under narcosis or spinal anesthesia tolerate the procedure poorly.

Two roentgenograms. CHARLES M. NICE, M.D.
University of Minnesota

Preliminary Report on the Use of a New Contrast Medium: Angiopac. Jean-Louis Léger. *J. Canad. A. Radiologists* 3: 38-41, June 1952.

Angiopac is an ethyl-di-iodostearate manufactured by L'Union Chimique Belge, Brussels. Like Thorotrast, Angiopac is a colloidal suspension, but, unlike Thorotrast, it is not radioactive. It is eliminated by the kidneys largely within twenty-four hours and is therefore unlikely to cause the fibrosis of the liver and spleen which is a serious problem with Thorotrast. Extravascular deposits of the suspension are not readily absorbed, and, since complications of this error in administration are not yet known, it is to be avoided. Angiopac is well tolerated in doses of 1 c.c. per kilogram. Given in doses of 10 c.c. at a time, it is not irritating to the vessel, causing little distress. The size of a grain of Angiopac is one-fifth that of a red blood cell and it is therefore not a source of embolism. For opacification of vessels, it compares favorably with Diodrast. It is not determined whether Angiopac opacifies the smaller vessels more often because of absence of vascular spasm or because it is less easily diluted by the blood stream than Diodrast.

The suspension was used in 23 angiograms. The only reaction thought to be directly related to the use of Angiopac was shivering or chilling, which was experienced by 4 patients. It may be related to the mobilization of the phagocytic reticulo-endothelial cells consequent to injection of the medium. Since Angiopac is phagocytized by the reticulo-endothelial cells, it accumulates in the liver and spleen. The liver and spleen are opacified fifteen minutes after injection. The medium begins to disappear from these organs after the first hour.

Hepatosplenography was attempted with Angiopac in 4 cases. The dose for each case was 30 c.c. intravenously. Three patients noted a sensation of heat before the end of the injection. This was probably due to the large volume used at a single injection. Two patients (age twenty) had no late reaction. One forty-year-old adult had a late chill. The fourth, aged forty, had a generalized allergic reaction and transient

lymphadenopathy. This was probably a marked reticulo-endothelial response. Opacification of the spleen was found to be good, while opacification of the liver was poor. Further studies of dosage and optimum time of opacification may improve the visualization of the liver.

Two tables.

RICHARD F. MCCLURE, M.D.
Camp Pendleton, Calif.

Preliminary Experience in Hepatolienography with Ethyl Di-iodostearate (Angiopac). Rossi and Baronchelli. Paper presented before the Italian Radiological Society, Florence, Italy, March 2, 1952. Abstract in Radiol. med. (Milan) 38: 563-564, June 1952. (In Italian)

Angiopac is an iodine preparation of high viscosity used in Europe for arteriography. The essayists have noticed that following the slow intravenous injection of Angiopac the spleen becomes highly opaque, the opacity being similar to that obtained by Thorotrast. This opacity reaches a maximum after three hours and disappears within twenty-four hours following the injection. The opacity of the liver is not appreciably increased with this method. Angiopac was used in 10 patients without ill effects.

CESARE GIANTURCO, M.D.
Urbana, Ill.

The Technique of Translumbar Arteriography. Parke G. Smith, T. W. Rush, and Arthur T. Evans. J.A.M.A. 148: 255-258, Jan. 26, 1952.

A simple and safe technic of abdominal arteriography is described, 1,000 aortic punctures having been made without fatality or significant morbidity. The method is now used routinely by the authors in diagnostic studies of the upper urinary tract, uremia and intolerance to thiopental sodium anesthesia being the only restrictions. Satisfactory arteriograms are obtained in 9 of 10 aortic punctures. The indications for the procedure and causes of poor results are discussed together with certain considerations for safety. Studies were made of the puncture site at autopsy following death due to other causes. In only 6 of 36 patients was there blood outside the aorta; in no case was this complication of major importance.

Two roentgenograms; 2 photographs.

M. M. FIGLEY, M.D.
University of Michigan

The Experimental and Clinical Investigation of Various Media Used in Translumbar Aortography. W. F. Melick, John E. Byrne, and Tom D. Boler. J. Urol. 67: 1019-1025, June 1952.

The possible dangers of translumbar aortography are (1) hemorrhage from the puncture site in the aorta, (2) gut necrosis from injection of the medium directly into the superior mesenteric artery, and (3) sensitivity reactions to the medium. Only gut necrosis due to the irritation of sodium iodide has led to any reported deaths. In order of density, sodium iodide is most opaque to x-rays, followed in order by 70 per cent Urokon, 75 per cent Neo-iopax, and 70 per cent Diodrast. This is in accordance with the iodine content of each medium.

Tests of these compounds in guinea-pigs and dogs indicated that body tissues reacted least to Urokon and Neo-iopax, and that sodium iodide alone produced gut

necrosis. Because of its lower tissue reaction, greater opaqueness to x-rays and failure to produce gut necrosis, 70 per cent Urokon was used in translumbar aortography in 35 patients, 10 of these cases were done under local anesthesia. The reactions of the patients consisted of moderate cramping when the injection was made, followed by nausea and infrequently vomiting. The opacification of the aorta and its major branches was suitable for diagnosis.

Eight roentgenograms; 4 tables.

RICHARD F. MCCLURE, M.D.
Camp Pendleton, Calif.

Venography in Chronic Venous Insufficiency of the Lower Extremities. Mathew W. Kobak, Samuel Perlow, and Robert A. Arens. Illinois M. J. 101: 312-316, June 1952.

Venography of the lower extremities can be used to demonstrate incompetency of the superficial, communicating and deep veins, as well as the presence and site of occlusion. Ordinary pyelographic media are used—Diodrast and Urokon were both employed by the authors.

To visualize the superficial veins, they are injected percutaneously and the desired films are exposed. This is seldom necessary but may be indicated with gross thickening of the subcutaneous tissues.

The communicating veins, if incompetent, are demonstrated by injecting the contrast medium into a vein on the dorsum of the foot with the x-ray table tilted 75° upright and a tourniquet above the ankle. Elastic bandages or multiple tourniquets are sometimes used to get the medium into specific areas. A small test dose is injected first, followed by 15 c.c. given in ten seconds. The anteroposterior film is exposed, an additional 5 c.c. is injected, and the lateral view is obtained.

The time of disappearance of the medium from the extremity is a measure of the flow in the deep veins but, if more information is needed, a retrograde injection is made into the femoral or popliteal vein in the 75° upright position. The deep veins may also be demonstrated by injection into a vein on the dorsum of the foot after the superficial veins have been occluded with elastic bandages. This is done with the table horizontal.

Several or all of these technics may be necessary in any given case. Four representative histories are presented.

Eleven roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Use of Filters to Control Radiation Exposure to the Patient in Diagnostic Roentgenology. E. Dale Trout, John P. Kelley, and George A. Cathey. Am. J. Roentgenol. 67: 946-962, June 1952.

Patient exposures encountered with the usual diagnostic equipment at various kilovoltages (50-130 kv.p.) with increasing thickness of filtration (0-3 mm. Al) were measured. It is convincingly shown that even small amounts of additional filtration reduce the dose rate strikingly. With 2 mm. of Al the dose rate was reduced by about 80 per cent at 50 kv.p.; 70 per cent at 100 kv.p., and 60 per cent at 130 kv.p.

In roentgenography it is the radiation that is transmitted through the part that is effective. So far as is understood at present, the radiation that is not trans-

mitted through the part produces no useful effect. Studies with phantoms showed that the addition of a filter increases transmission, at the same time reducing the incident dose. It would appear from the phantom transmission curves that the quality of the resulting roentgenogram should not be significantly altered.

Clinical trials with a fixed potential but altering the filter and keeping film density constant showed that the dose was reduced by a much greater factor than the increase in exposure time as filter was added. With added filtration up to 2 mm. Al (50 to 70 kv.p.) no significant changes in roentgenogram quality were produced. Above 70 kv.p. 3 mm. Al could be used. The highest voltage and the thickest filter consistent with adequate diagnostic contrast are recommended to reduce the patient dose. The following are suggested: 2 mm. Al at 50 to 70 kv.p.; 3 mm. Al at 70 to 100 kv.p.; and up to 0.25 mm. Cu above 100 kv.p.

In the ensuing discussion the authors were commended for their thorough analysis of the effects of filtration and kilovoltage on patient radiation exposure. Seventeen roentgenograms; 15 graphs; 10 tables.

ZYGMUNT S. GIERLACH, M.D.
University of Louisville

Photoroentgenography at High Voltage (100-180 kv.) and Low Current (2-8 ma.). Franco Fossati. *Radiol. med. (Milan)* 38: 552-556, June 1952. (In Italian)

The author has employed voltages as high as 180 kv. and milliamperage as low as 2 ma. in an effort to decrease the tube load and the exposure of the patient during photoroentgenography. The electrical energy required is only $\frac{1}{20}$ of the usual amount and the results shown by the radiographs are quite good.

Ten roentgenograms. CESARE GIANTURCO, M.D.
Urbana, Ill.

RADIOTHERAPY

Reticulum Cell Sarcoma. Report of a Thirteen-Year Survival Following One Thousand Roentgens of X-Ray Therapy. Knowles B. Lawrence and Norman Lenson. *J.A.M.A.* 149: 361-362, May 24, 1952.

The usual life expectancy in reticulum-cell sarcoma is six to twenty-four months from the time of diagnosis. This rather inadequate case report concerns a patient who had survived thirteen years after x-ray treatment and was presumably well at that time. A swelling in the right supraclavicular fossa brought this girl to the hospital when she was sixteen years old. The swelling was nodular, firm, and fixed. During the period of observation the mass enlarged and ruptured centrally. Numbness developed in the fingers of the right hand and small hard nodes were felt in the right axilla. Laboratory studies were normal. Surgical exploration revealed that the mass could not be excised and biopsy was done. The microscopic picture was that of a highly anaplastic tumor with very vascular stroma, presumably reticulum-cell sarcoma. Radiation therapy was given to one supraclavicular port, 10×15 cm., (200 kv., 50 cm. target-skin distance) for a total dose of 1,000 r.

Two photomicrographs. PAUL W. ROMAN, M.D.
Baltimore, Md.

Neuroblastoma with Skeletal Metastases and Apparent Recovery. O. William Anderson. *Am. J. Dis. Child.* 83: 782-787, 1952.

Neuroblastoma is a malignant tumor primarily of infancy and early childhood. Ordinarily it grows rapidly, metastasizing widely and early. The average duration of life after diagnosis is less than six months. The tumor grows from cells whose origin can be traced to the primitive neural crest of the ectoderm and therefore is said to be neurogenic in origin. Commonly the original site is the medulla of the adrenal gland, which is a derivative of the neural crest. Less often the tumor arises in sympathetic tissue elsewhere in the body.

Beck and Howard (*Am. J. Dis. Child.* 82: 325, 1951. *Abst. in Radiology* 59: 626, 1952) in a review of 475 cases, revealed the fact that neuroblastoma need not be fatal. They uncovered 47, or 10 per cent, cures in this series. The majority of patients who have been reported as cured in recent years have had complete or

partial surgical excision of the original tumor and/or x-ray therapy.

The author reports a case which received no x-ray treatment. Shortly after what seemed to be complete removal of the tumor, when the patient was seven months of age, painful and progressively destructive lesions of both femurs developed. These were diagnosed as metastatic neuroblastoma. The only treatment given was a short course of corticotropin, without immediate observable effect. At the age of twenty-one and a half months, however, roentgenograms of the femurs were found to be entirely normal. At twenty-six months, the child appeared normal in every way and was making excellent progress.

Four roentgenograms; 1 photomicrograph.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Contribution to the Immediate Dark-Field Cytodiagnosis of Cancer Cells. Preliminary Communication. Waldemar E. Coutts and Edna Silva-Inzunza. *Rev. chilena hig.* 14: 119-121, July-September 1952. (In Spanish)

A method of cytodiagnosis of cancer applicable to urine or other fluids, or tumor scrapings, is described. The material to be examined is mixed on the slide itself with a 10 per cent solution of formol. The slides are then observed under dark-field illumination. The characteristics of cancer cells are well differentiated from the normal cells. The whole procedure takes but a few minutes.

Eleven illustrations.

L. GUZMÁN, M.D.
Santiago, Chile

Cytological Changes in Vaginal Smears in Radium and Roentgen Irradiation of Uterine Carcinoma and Their Prognostic Significance. Preliminary Report. Anna Margrethe Nielsen. *Acta radiol.* 37: 479-486, May 1952.

The author reports 100 cases of uterine carcinoma in which serial cytological smears were used to indicate the prognosis during radiotherapy.

Among 73 cases showing evidence of favorable changes in the smears, there were 6 recurrences. Good

prognosis was held to be indicated by increased destruction of malignant cells and the formation of atypical normal cells. In 27 cases showing evidence of poor prognosis, there were 21 recurrences.

A table lists the cases according to clinical stages. The longest follow-up was two years and eight months. It is concluded that serial cytology studies during radiotherapy afford a means of prognosis.

Six photomicrographs. A. R. BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

The Role of Radiation and of Surgery in the Management of Uterine Carcinoma. Franklin L. Payne. *Surg., Gynec. & Obst.* 94: 715-721, June 1952.

The reports from specialized clinics of the growing use of surgery in the treatment of gynecological cancer has led to some confusion as to the comparative roles of radiation or surgery. The author reviews the results from the University of Pennsylvania and concludes that the newer radical surgical procedures had best be restricted to highly specialized teams and that much of the eviscerative surgery should be classified as experimental.

Carcinoma of the Corpus: Even with the improved methods of therapy, from one-third to one-half of all patients with carcinoma of the corpus still succumb to the disease. When the lesion is apparently confined to the uterus the situation is surgically enticing inasmuch as there appears to be a chance for immediate anatomical eradication by quick hysterectomy. The results from this method, however, run a poor second to the traditional combined method of therapy which includes preoperative radium treatment.

Two hundred and eleven patients with corpus cancer were treated between 1931 and 1945. One hundred and sixty-three of these were thought to be operable. The results were as follows:

Method of Treatment	Cancer Confined to Uterus	
	No. of Patients	Free of Cancer
Hysterectomy	46	37 (80.4%)
Radium and hysterectomy	28	26 (92.9%)
Hysterectomy and irradiation	24	18 (75.0%)
Radiation	65	27 (40.8%)

The prognosis is related to uterine size. When the technically operable group is subdivided into three groups according to size, that is, (a) no enlargement, (b) not above the size of a two and a half months pregnancy, (c) enlargement above that size, the survival rate decreased as the enlargement increased in the order of 82, 62, and 34 per cent. There were 45 patients in whom the lesion spread beyond the confines of the uterus when first seen. There were no survivals following operation alone and none following surgery with subsequent irradiation. Seven patients (15 per cent), however, survived five years following irradiation alone.

In view of the better results with the combined method of treatment an attempt should be made to elevate the inoperable patient into the surgical group by intensive irradiation. If no surgery can be anticipated, further irradiation to the full limit of tolerance should be undertaken. Thereafter, no more intensive irradiation is considered. Experience has taught the author that anything more than palliative therapy for

recurrent growth following previous intensive irradiation is ineffective and may even be harmful.

The recent references to the promise of improved results by radical hysterectomy with extensive regional dissection should remain in the field of clinical experimentation until its value has been proved. Evisceration may have a place as a measure of desperation, but this approach is also in the experimental stage.

Carcinoma of the Uterine Cervix: The steady improvement of the results from radiotherapy in the large clinics leads the author to believe that we have not reached the ultimate effectiveness in the management of cervical carcinoma. The results of irradiation in 183 patients with carcinoma of the cervix treated at the Hospital of the University of Pennsylvania, between 1940 and 1945, are as follows:

Clinical Stage	No. of Patients	Relative Apparent Recoveries
I	46 (25%)	34 (74%)
II	68 (37.2%)	31 (45.6%)
III	55 (30.1%)	15 (27.3%)
IV	14 (7.7%)	2 (14.3%)

The survival rate for patients in Stages I and II combined is 57 per cent, while 24 per cent of those in the more advanced stages (III and IV) survived.

Statistics, edited by Heyman, from nine different clinics show an apparent five-year recovery rate of 201 operative cases (Stages I and II) of 63.7 per cent. It is pointed out, however, that these statistics refer to a highly selected group of cases. A series of cases treated by radiotherapy only and similarly selected is not available. Both the radical operation and the modern concepts of radiation therapy have been in vogue too little time for evaluation of their ultimate effectiveness. Until sufficient time elapses to permit the accumulation of adequate data for the comparison of the two, the keystone of the day to day therapy for invasive cervical cancer should continue to consist of irradiation.

The radical operation should be undertaken only by those well qualified to deal with the major surgical problems of the pelvis and abdomen. Anything less than the radical procedure, consisting of total hysterectomy, with excision of the regional lymph nodes, the parametrial, pararectal, and paravaginal tissues, and the upper vagina is futile.

Six tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Controversial Points in the Treatment of Carcinoma of the Cervix. Howard C. Taylor, Jr. *Cancer* 5: 435-441, May 1952.

In 1940, the principles of treatment of carcinoma of the cervix were widely agreed upon. Since that time various developments have resulted in the upsetting of this perhaps prematurely standardized method of management. A borderline lesion, "intraepithelial carcinoma," has appeared, about whose exact potentialities even the pathologists are in doubt. In view of the uncertainty as to the potentialities of this lesion, there is understandable lack of agreement in regard to the type of treatment which should be employed, varying from simple conization of the cervix to a modified Wertheim procedure. Since cervical carcinoma occurs most frequently in young women, the need for greatest possible safety against recurrences must be counterbalanced by the responsibility for avoiding needless destruction of reproductive function. The author be-

believes that cauterization followed by careful observation is a justifiable procedure to follow in cases with no stromal or glandular invasion. In his clinic, the desirability of further pregnancy takes an important place in the decision, and total hysterectomy is reserved for patients of thirty or thirty-five or more.

The demonstration that an isolated cancer cell is recognizable by the trained pathologist and that cancer of the uterus may be diagnosed by examination of a preparation of vaginal secretions or cervical scrapings has opened up vast possibilities. The place of the vaginal smear as a reliable instrument in clinical diagnosis depends on the accuracy of diagnosis by this method. A real problem in assaying the accuracy is the frequency of false negative and false positive reports. When cancer is present, it is detectable in about 85 to 90 per cent of the cases. False positives occur in about 1 per cent of the benign cases. A false positive report, however, may result in considerable distress to the patient.

Numerous authors believe that cervical cancer prevention by screening of the female population is an attainable goal. It must be pointed out that more than a thousand routine examinations will have to be made before a case of cancer of the cervix is likely to be found; the cost of detecting such a case may run into the thousands of dollars.

The place which treatment by radiation or surgery, or by the modalities combined, should occupy is also a point of controversy. If irradiation can be demonstrated to have a real effect on the regional lymph nodes, the author believes that it has an assured future. Otherwise it is inevitable that surgery will re-establish itself in the treatment of carcinoma of the cervix. In determining the distribution of cases between surgery and irradiation, to give the largest aggregate five-year cure rate, the author discusses the low-operability, medium-operability and high-operability schools of thought as well as the total operability concept which is the ideal at several institutions. He points out the unexplored possibilities in the radiation field—radioactive cobalt, radioactive colloidal gold and roentgen rays of ever increasing voltage. At present it seems difficult to believe that a "best method" will emerge for decades.

In conclusion, the problem of statistical reporting of results is touched upon. The author believes that results in the treatment of intraepithelial lesions must be reported separately and that the principle of the absolute cure rate must be maintained.

A bibliography of 49 articles is appended.

D. S. CHILDS, JR., M.D.
Rochester, Minn.

The Association of Radium and Surgery in the Treatment of Carcinoma of the Cervix. David W. Currie. *Proc. Roy. Soc. Med.* 45: 327-331, June 1952.

Since 1936 the author has operated upon 122 patients with carcinoma of the cervix. The present report deals with 103 of these, a consecutive group, the 19 others being treated after the tabular material was compiled. Clinically most of the cases were Stages I and II.

As a rule a patient received one application of radium (40 mg. in the canal and 40 mg. in each lateral fornix, left *in situ* for twenty-four hours) for a dose equivalent to 2,880 mg. hrs. Three weeks later the operation was performed. The author sees no value in subjecting

the cervix and surrounding organs to full radiation treatment when eventually the uterus is to be removed altogether.

In 26 patients in this series the lymph nodes were involved. The author observed that the nodes invaded even in the earliest growths are not touched by the radium with the technic and screenage used at present.

Four days prior to surgery the patient is hospitalized for prophylactic penicillin and vaginal cleansing, and a blood transfusion if indicated. At operation the broad ligaments are clamped and then the intra-abdominal and pelvic lymph nodes are removed by dissecting downward toward the uterus and bladder. The tubes, ovaries, and uterus are then removed (the operative technic is described in full). [With this operative regimen, it is difficult to find any real need for the non-cancerocidal radium application (except to the cervix, which is also removed).—Z.S.G.] In the series of 103 patients, there was no immediate postoperative death and complications have been rare. The percentage of relevant cures after five years is 79.5 per cent and after ten years 66 per cent. Ten of 15 patients operated upon more than ten years and 35 out of 44 more than five years are still alive.

The author states that if present-day results are to be improved, we must have recourse to expert surgery, even in late cases.

Z. S. GIERLACH, M.D.
University of Louisville

Treatment of Benign Uterine Bleeding with Intracavitary Radiation. J. Mason Hundley, Jr., William K. Diehl, and Theodore Kardash. *Am. J. Obst. & Gynec.* 63: 1234-1244, June 1952.

The following general indications are listed for intracavitary irradiation for benign uterine bleeding: The patient should be at least forty years of age, when further childbearing is not to be considered; conservative measures should have been carried out unsuccessfully; the patient should be a poor operative risk, as a result of severe hypertension, cardiac disease, or other debilitating condition. The procedure is also indicated in patients at the menopause having small uterine fibroids, preferably excluding the submucosal type, and infrequently in women fearful of operation. Important contraindications are pelvic inflammatory disease, ovarian masses, and large uterine tumors. Submucous myomas may or may not be a contraindication.

Blood dyscrasias may be the cause of uterine bleeding. It may be associated with acute leukemia, aplastic anemia, essential thrombocytopenic purpura, secondary thrombocytopenic purpura, hereditary hemorrhagic telangiectasis, or constitutional thrombopathy (von Willebrand's disease).

If no malignant tissue is found by diagnostic curettage (which is always done), an intracavitary application of radium, 100 mg. in tandem, is carried out, with filtration of platinum and iridium (2 mm. lead equivalent) for a dosage of 2,000 mg. hr. The action of the radiation is twofold. The major effect is upon the follicular system of the ovary and the minor effect is upon the endometrium, the end-result being complete regression of the ovary in the vast majority of cases and destruction of the endometrial glands. If curettage reveals fundal carcinoma or a suspicious hyperactive, hyperplastic endometrium, multiple-source irradiation is carried out with a greatly increased dosage.

The authors do not believe that using intracavitary

irradiation for benign conditions will increase the incidence of endometrial carcinoma. They review a series of 175 patients treated as outlined above. In 117 of these, abrupt cessation of bleeding occurred. Of the 9 failures, 6 are attributed to the presence of fibromas, predominantly of the submucous type. No deaths occurred in the series. In only 1 patient did carcinoma subsequently develop.

Two photomicrographs; 8 tables.

JOHN M. KOHL, M.D.
Jefferson Medical College

Stump Carcinoma: Its Treatment and the Relation Between Parity and Incidence. T. F. Redman. *Proc. Roy. Soc. Med.* 45: 331-334, June 1952.

A survey of the literature shows that the incidence of carcinoma in the uterine stump is as high if not higher than that in the cervix of the intact uterus and that the case for panhysterectomy is well established. The author considers two aspects of stump carcinoma: the incidence in nulliparous women and the treatment of the condition.

The incidence of stump carcinoma is significant. Nulliparity does not offer the same degree of protection against carcinoma in the woman with a cervical stump as it does in the woman with an intact uterus—another argument against supravaginal hysterectomy.

In a composite series, a 25 per cent five-year salvage of "true" stump carcinoma (occurring two or more years after subtotal hysterectomy) was obtained with the use of radium. In a small group of patients treated by surgery the five-year salvage was about 50 per cent.

In a new series from Christie Hospital, Manchester, 1943-45, a 37 per cent five-year survival rate is reported for 43 patients with "true" stump carcinoma and a 31 per cent five-year survival for 16 patients with "coincident" stump carcinoma (found within two years of hysterectomy). All of these cases were treated by radium.

The author feels that a review of the method of attack on stump carcinoma is indicated at this time for "within a generation it is hoped that few stumps will exist to turn cancerous and the opportunity for assessing the results of treatment will have been lost."

Z. S. GIERLACH, M.D.
University of Louisville

Irradiation of the Nasopharynx in Children with Infectious Asthma. Harry L. Mueller and Carlyle G. Flake. *New England J. Med.* 246: 924-927, June 12, 1952.

After a brief historical review, the author reports on the radiation treatment of 41 children, from a year and a half to eleven years of age, with follow-up varying from six months to four years (85 per cent followed for more than two years). The criteria for selection of patients were: (1) severe asthma for over two years, plus associated respiratory infection; (2) failure of other methods to produce satisfactory results in infectious asthma; (3) control or stabilization by allergic treatment and management of any accompanying asthma due to other allergens; (4) presence of hypertrophied lymphoid tissue in the nasopharynx, or evidence of infection, or both.

The severity of asthma was graded from 0 (infection only) to 4 (constant asthma with frequent infections).

Two methods of treatment were used. (1) Twenty-six patients were treated with the standard monel-

metal applicator, receiving 3 applications at intervals of one to four weeks, 100 mg. (50 mg. to each side) for eight to ten minutes on each occasion. In 8 cases a second series was given six to twenty-four months later, but in no instance was the interval less than twelve months if the initial applications had exceeded eight minutes. (2) Fifteen patients were treated by roentgen rays. Each received a series of two treatments, one to three weeks apart, with 100 r for eight to ten minutes. One patient was retreated nine months later.

Since there was no marked difference in the results with the two methods of treatment, these are not reported separately. Of the entire group of children, 11 (27 per cent) obtained complete relief for two to four years; 17 (41 per cent), with Grade 1 asthma, obtained excellent results for a year and a half to four years; 5 (12 per cent) had a fair result; in 8 (20 per cent), with Grade 3 and 4 asthma, the result was unsatisfactory.

The authors conclude that good results are dependent on reduction in frequency and severity of respiratory infections, although the mechanism that affords relief is not understood.

MARSHALL B. TUCKER, M.D.
Oakland, Calif.

The Place of Radiotherapy in the Treatment of Simple Skin Conditions. Alexander A. Charteris and James Sommerville. *Proc. Roy. Soc. Med.* 45: 403-410, June 1952.

Charteris believes that the treatment of simple skin conditions by means of irradiation is better carried out when there is close cooperation between dermatologist and radiotherapist. The radiotherapist should provide properly calibrated apparatus and see that the prescriptions are accurately carried out. His experience with the long-term effects of x-rays, especially in planning treatment for the more chronic or recurrent cases, is most valuable. The deleterious effects of irradiation on the growing tissues of young people can also be better evaluated by him. Radiotherapy is not employed routinely in simple skin conditions but only after the use of other modalities has been considered.

The author discusses the results in three conditions in which he has had extensive experience. In 286 cases of plantar wart treated no difference in the efficacy of radium and of x-ray was noted, satisfactory results being obtained in between 80 and 90 per cent of cases. No unpleasant effects were observed since the author did not give more than one course of treatment to any patient. With radium, 1,300 r incident dose in six hours was delivered and by x-ray 1,200 r in three doses over a week, or less often, 1,000 r in a single dose, mostly at 85 kv. Fifty-four keloids were treated, only 11 in association with surgery. Doses of 300 r monthly for three or perhaps four doses, at 85 kv., were given. Radium molds were also used, 500 r being given at each exposure. The results were excellent in a great majority of the cases. Hemangiomas in children were found to be eminently treatable. Treatment was with radium mold at 0.5 cm. distance and dose at skin of 400 r, repeated in a month, and thereafter as regression dictated. Less often roentgen therapy was used at 85 kv. with individual doses of about 300 r. In 564 cases, failure to achieve regression was noted in only 11. Twenty per cent had a good result and the rest were classified as "excellent." No additional damage to the skin was noted on any case.

Sommerville presents, in tabular form, details of dosage and results, in various skin conditions treated

by roentgen rays—sycosis barbae, furunculosis, paronychia, acne vulgaris, hyperidrosis, pompholyx, pruritus ani, lichen simplex, dermatitis lichenoides, dermatitis infectiosa, dermatitis venenata, and sensitization dermatitis.

Fourteen tables.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Depth-Dose Data for Roentgen Radiation at 30-100 Kilovolts. H. C. Burger, R. Braams, and J. F. C. Werz. *Acta radiol.* 37: 531-542, June 1952.

With a view to clinical application, the authors have investigated the influence of such factors as voltage, filtration, and diaphragm on depth-dose curves for roentgen rays of 30 to 100 kv. from a tube with an inherent filter of 1.0 mm. Al. The influence of sulfur in the skin and the back-scatter from bone were measured and found not to be of great importance.

The article is of interest but not adapted to abstracting because of the many charts and graphs which constitute an essential part of it.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

The Value of Preoperative Roentgen Irradiation in Operable Breast Cancer. Sigvard Kaae. *Acta radiol.* 37: 568-576, June 1952.

On the basis of five-year results in cases of operable and inoperable breast cancer treated at the Radium Center in Copenhagen, the author reaches the following conclusions:

Heavy preoperative roentgen irradiation supplementary to radical mastectomy does not appear to afford better results than moderate preoperative roentgen irradiation in cases which are definitely operable according to the criteria of Haagensen and Stout (*Ann. Surg.* 118: 859, 1032, 1943). At any rate, it has not lowered the incidence of recurrence in the irradiated area. Since breast cancer on the whole is rather radio-resistant, it is questionable whether anything has been gained by supplementing radical mastectomy by preoperative irradiation.

In locally and regionally advanced cases (inoperable according to Haagensen and Stout), the results of radical mastectomy may sometimes be improved by heavy preoperative roentgen irradiation. This group, however, is small, and the improvement obtainable appears to amount to merely a few per cent in the five-year results for all "operable" cases. It is therefore doubtful whether systematic preoperative roentgen irradiation ought to be continued as a supplement to radical mastectomy in all operable cases.

Three graphs; 2 tables.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Chromophobe Pituitary Tumors. II. Treatment. Gilbert Horrax, Hugh F. Hare, James L. Poppen, Lewis M. Hurxthal, and Omar Z. Younghusband. *J. Clin. Endocrinol. & Metab.* 12: 631-641, June 1952.

The treatment of chromophobe pituitary tumor or its complications is roentgen irradiation, surgery, or a combination of the two, and the administration of natural or synthetic hormonal substances when secondary glandular deficiencies exist. In the majority of cases the primary object of treatment is the arrest or restoration of visual loss, the secondary constitutional effects being inconstant and relatively unimportant in

comparison. To achieve the best result, however, the patient should also have relief of other symptoms, an increase in well being, and an ability to return to work.

In general, especially during the past ten years, the authors have employed roentgen irradiation before considering operation, when the reduction in vision has not been marked or when visual loss has not been rapid. The dose administered has varied in amount. It is now customary to give a tumor dose of 4,000 r by the rotational technic of Hare and Trump (*Am. J. Roentgenol.* 66: 613, 1951). The majority of the patients in the present series, however, received a smaller dose, approximately 1,800 r (tumor), given through two lateral 5-cm. temporal portals. Improvement, if any, may be prompt or gradual, occasionally occurring many months after cessation of irradiation. In the authors' experience there is nothing to indicate that preoperative roentgen therapy has any influence on the surgical mortality, nor does it appear to increase the technical difficulties of the surgical procedure. The pituitary area is irradiated routinely postoperatively. In all probability this lessens the incidence of recurrence.

Impairment of vision may occur as a result of hemorrhage into the adenoma during roentgen therapy. This may cause increased pressure to which the stretched optic nerves cannot accommodate. One patient died during the course of irradiation; autopsy revealed, in addition to a large tumor with extension into the middle fossa, a cerebellar pressure cone as the chief cause of death.

Except in rare instances, all the operations for chromophobe tumor in this series were performed by way of the intradural and transfrontal approach on the right side regardless of which eye had been most seriously affected. The main indications for surgery are: marked visual impairment; recent, rapidly advancing visual loss; progressive visual impairment despite adequate roentgen therapy; visual impairment arrested at an incapacitating level, despite irradiation; large tumors with extrasellar extension causing central nervous system symptoms, sometimes requiring air injection studies to demonstrate the extent of the lesion; a clinical picture not altogether typical of a pituitary tumor and compatible with another type of chiasmal lesion. In the present series there were 105 patients up to December 1949, who had been operated on for pituitary tumors a total of 133 times. In 66 instances the patients had irradiation either before or after, or both before and after, the surgical procedure. Of this number, 36 patients were operated on because roentgen therapy had failed to improve their vision or to maintain it at a useful level. Thirty-nine patients were subjected to operation only and had no irradiation at any time.

Ninety-two patients survived their primary operations irrespective of the size and extent of their tumors, an over-all mortality of 14.1 per cent for all types of growth with or without intracranial extension. Of this number, 68 were operated on before 1945, so that a follow-up period of five years or more has elapsed. Forty-nine of these 68 patients are known to have survived for from five to eighteen years, and 6 others for from one to four years.

Results of Treatment on Visual Apparatus: Under this heading, only the 105 patients with histologically verified adenomas are considered. Thirty-one patients in this group were treated by surgery only. Twenty-

seven of these have been followed from two to eighteen years. In 24 instances vision was improved for from three months to eighteen years, average, six years; improvement was maintained in 11 patients for from five to eighteen years and in 8 others for from two to four years.

Sixty patients treated by *surgery and irradiation* have been followed from a few weeks up to sixteen years; of these, 46 have been followed from two to sixteen years. In 41 patients vision was improved for from two to sixteen years, average six years and two months; in 18 of these visual improvement has been maintained for from five to sixteen years and in 16 others for periods of from two to four years. Vision was unchanged in 15 patients, for from a few weeks to thirteen years, and was worse in 3 patients.

Thirty-six patients underwent *surgery after failure of irradiation* to maintain vision at a useful level. Of the 32 survivors, 23 showed improvement after removal of the adenomas for from eight months to sixteen years (average, five and one-half years). In 8 patients, vision was unchanged. One patient became blind after his final operation.

Twenty-seven patients were treated by *irradiation only* because of impairment of vision. In 16 patients vision was moderately to markedly improved by roentgen therapy; in 11 vision was either unimproved or became worse.

Results of Treatment on Endocrine Functions: As to recovery from hormonal deficiencies after either irradiation or surgery or both, little success was achieved. It is not at all improbable that success might follow operation or even irradiation in cases of short duration; it is not likely, however, that many of these tumors will be recognized early because of the frequent insidious onset. Experience has shown that improvement in the state of hypopituitarism rarely follows either roentgen therapy or surgery. During the past two years ACTH was administered to 12 patients (not all from this series); its effects have been exceedingly gratifying in that greater endurance and a feeling of well-being have resulted.

It is the authors' impression that it is still worth while to administer testosterone and desoxycorticosterone, as the daily requirement of ACTH may be lessened. In patients manifesting clinical evidence of myxedema, definite and often marked improvement is obtained with desiccated thyroid alone, whereas such therapy may not help patients with panhypopituitarism who do not present such clinical evidence. Desoxycorticosterone causes an increase in blood pressure and an increase in the sense of well-being.

This paper follows one by the same group on the diagnosis of chromophobe pituitary tumors (for Abst. see p. 609).

One chart.

RADIOISOTOPES

The Clinical Applications of Radioactive Isotopes in Small Hospitals. Frank E. Hoecker and Homer L. Hiebert. *J. Kansas M. Soc.* 53: 273-275, June 1952.

The writers describe a program set up in co-operation with the physicians and hospitals of the Topeka (Kansas) area to make available to their community the advantages of radioactive isotopes. Under somewhat less than ideal conditions, a number of problems have been encountered which might be typical of any attempt under similar circumstances.

To meet the requirements of the Atomic Energy Commission, which exerts complete control over the use of radioactive isotopes, laboratory space was obtained in a local hospital, the services of a certified radiophysicist were secured through the University of Kansas, and funds for the purchase of suitable equipment were provided. A preparatory orientation course on the medical application of radioactive isotopes was given through the University of Kansas Extension Division to a group of 25 interested physicians.

The first isotope clinic was held in July 1951 and at the time of the present report eight monthly sessions had been held. Fifty-eight radioactive iodine tracer studies had been made, and 18 therapeutic doses of ^{131}I administered for thyrotoxicosis. In addition, 2 cases of polycythemia vera, 1 of multiple myeloma, and 1 of skeletal metastases had been treated with radioactive phosphorus.

It is hoped to expand this service to accommodate the increasing patient load and to include other radioactive materials as they become available. This, it is believed, can be accomplished by (1) substituting mechanical devices for technical assistance wherever possible and (2) by training existing hospital personnel to do much of the routine work, including sample measure-

ments, thus giving the radiophysicist and radiologist more time to analyze and to evaluate the results.

Dynamics of Calcium Metabolism. Time Distribution of Intravenously Administered Radiocalcium. R. O. Thomas, T. A. Litovitz, M. I. Rubin, and C. F. Geschickter. *Am. J. Physiol.* 169: 568-575, June 1, 1952.

The disappearance from the blood, the uptake by the bones, and the excretion *via* the urine and feces of tracer radiocalcium was investigated for groups of normal young and adult rabbits. Mathematical analysis of the blood disappearance curves obtained in this study indicated that four exponential terms are needed to represent the data. For the first two terms the rates of exchange of calcium between plasma and extravascular components were calculated and shown to be in good agreement with data previously obtained by others for other ions. Within the experimental accuracy, these rates were found to be the same in both young and adult rabbits. The third term in the blood disappearance has been correlated with the bone uptake of calcium. The bone uptake of radiocalcium in the young age group was greater than in the adult age group. Therefore, it has been shown that the third blood term for the disappearance of calcium is a measure of bone activity. The fourth term from the equations expressing blood disappearance rates has been correlated with the excretion of calcium *via* the urine and feces. This excretory output has been found to be an inverse function of the bone uptake of calcium.

From this study it was deduced that a mathematical analysis of blood disappearance data and excretion data for calcium can yield information regarding bone activity.

Five charts; 3 tables.

Transport of Radioactive Iron in Intestinal Lymph. Ralph E. Peterson and Joseph D. Mann. *Am. J. Physiol.* **169**: 763-766, June 1, 1952.

Radioactive iron was administered orally and parenterally to rats with total intestinal lymph fistulas in an attempt to determine the relative contribution of these possible sources to the iron content of the intestinal lymph. Only an insignificant portion of the orally administered radioactive iron appeared in the lymph—less than 0.1 per cent of the total amount of radioactive iron administered and only 2.0 to 5.0 per cent of the total amount of iron absorbed from the gastrointestinal tract after eight hours. Between 2.0 to 5.0 per cent of the total amount of iron administered to the rat was absorbed from the gastrointestinal tract, and more than 50 per cent of this iron was found in the liver at eight hours (absorption through the portal system), as contrasted to the 2.0 to 5.0 per cent that appeared in the intestinal lymph. Approximately 0.5 per cent of a parenterally administered dose of iron appeared in the intestinal lymph of rats after eight hours, and 60 to 70 per cent appeared in the liver.

The data on 11 rats studied after oral iron administration would seem to indicate that only an insignificant amount of iron is absorbed from the gastrointestinal tract by the intestinal lymph, and that the very small amount of iron appearing in the lymph after oral administration may be partially, if not entirely, accounted for by reabsorption from the blood stream.

Two tables.

Medical Uses of Cobalt 60. Herbert D. Kerman. *South. M. J.* **45**: 495-501, June 1952.

The physical and radioactive properties of cobalt are described. Some of the current and potential medical uses are discussed. It is emphasized that a great many of the potential uses are still only possibilities and must await further development. Radiocobalt, aside from the obvious financial advantage, has many superiorities over radium. The more important advantages are listed as follows:

1. Gamma radiation is simpler, essentially monochromatic, and no filtration is necessary.

2. There is a reduction in both the primary and secondary electronic emission so that less shielding is necessary to avoid troublesome local necrosis. This shielding does not appreciably reduce the gamma intensity.

3. A more homogeneous linear source of radioactivity can be prepared without the danger of "shifting" or localized "hot spots" in interstitial applicators.

4. It is not necessary to pack the inconvenient powder form of radioactive material into a container, and the magnetic property of cobalt facilitates handling.

5. There are no gaseous or inconvenient products of disintegration and the "radon leakage" problem disappears.

6. The hazards of radioactivity's being absorbed and retained are minimal as breakage is eliminated and adequate sheathing can be provided.

7. Should absorption of radiocobalt in tissue occur, it is rapidly eliminated and not stored in the body as is radium.

8. Greater flexibility of treatment is possible with radiocobalt, as a variety of design, shape and activity may be obtained easily and cheaply for special problems. In a great many instances these may be fabri-

cated before insertion into the reactor so that excessive handling of radioactive materials is minimized.

9. High specific activity sources of radiocobalt may be obtained for teletherapy irradiation, which will be far superior to large quantities of radium and compare quite favorably with x-ray therapy equipment in the supervoltage range.

Three illustrations.

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Jefferson Medical College

The Installation of Co⁶⁰ in a Gamma Ray Beam Unit. Hazel Merewether, S. B. Osborn, and S. J. Wyard. *Acta radiol.* **37**: 459-468, May 1952.

The authors describe the installation of cobalt in a teleraadium unit. The unit was designed to accommodate 10 grams of radium. The equivalent strength of Co⁶⁰, which is 6 curies, was used. This was supplied in the form of ten metal slugs. These sources are mounted in the outermost holes of the bobbin. The remaining holes are intended for use when additional Co⁶⁰ has to be added to compensate for decay. The authors estimate that, with the specific activity of the present sources, 30 curies can be accommodated in the standard bobbin, and more than this when higher pile factors permit the production of stronger sources. Such a five-fold increase in strength would be desirable and would not involve significant radiation hazards. The advantages and disadvantages of Co⁶⁰ over radium in a beam unit are discussed.

Six figures; 3 tables.

A. R. BENNETT, M.D.
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Radiocobalt in the Treatment of Bladder Tumors. John W. Schulte, Frank Hinman, Jr., and Bertram V. A. Low-Beer. *J. Urol.* **67**: 916-924, June 1952.

Radiocobalt has certain physical advantages over radium. (1) The metal cobalt can be made safely into convenient beads of any size and shape before activation. (2) Cobalt can be made radioactive to any desirable strength. (3) The undesired low-energy beta radiation, 0.3 mev, is easily screened by 0.1 mm. thick silver plating. (4) The gamma radiation, upon which the therapeutic effect depends, is almost monochromatic, with a mean energy of 1.2 mev, while radium gives off more heterogeneous rays, with a mean energy of 0.8 mev. (5) For equal dosage units 1 millicurie of Co⁶⁰ approximately equals 1.65 milligram of radium. (6) Radiocobalt decays to the stable element nickel, whereas radium disintegrates through a series of radioactive daughter products into the stable element lead. (7) The one disadvantage of radiocobalt is its shorter half-life, 5.3 years.

The rationale for the authors' method for use of radiocobalt is based on the dose distribution from a centrally located "point source" of radiation. Since the energy absorption in air closely parallels that in tissues for the high-energy cobalt gamma rays, in clinical practice there is very little difference in the dose at a given point in tissue and in a corresponding point in air within a radiation source-tissue distance not exceeding 4 cm.

A special balloon catheter holds the radiocobalt bead and permits the outflow of urine. This catheter is introduced into the bladder and inflated with 50 c.c. dilute sodium iodide containing a few drops of methylene blue. Anteroposterior, lateral, and oblique roentgenograms are made to measure the distance from the

bead to the tumor and to ascertain symmetry of the balloon. Dosage is calculated from the measured distance of tumor to bead, taking into account radiographic distortion. It has been the authors' practice to give 6,000 gamma roentgens at each insertion to the surface of the bladder, usually at a distance of 2 to 2.5 cm. from the radiocobalt bead. Each exposure lasts about one hundred hours. If one application is not sufficient, because of infiltrating tumor or lack of resolution after the initial dose, a second application is given after an interval of from four to six weeks.

This method of applying radiocobalt was employed in multiple papillomas without infiltration, localized tumors, and infiltrative tumors. Reactions of the bladder wall to radiocobalt appeared to be somewhat less severe than with similar doses of radium or externally administered x-irradiation. Doses of 6,000 gamma r produced erythema of the bladder wall. The patient usually complained only of dysuria and frequency. The second application produced a more severe reaction with edema and intense erythema, which required about two months to subside, leaving a contracted bladder.

Thirteen patients treated in this manner have been followed long enough for evaluation of the immediate results. Six received some benefit, but only 1 of these has remained free of recurrence. The authors feel that multiple papillomas may respond to intracavitary radiation; if not, surgical treatment, including cystectomy if necessary, should be used. Not even palliative improvement was obtained in the advanced, infiltrative lesions. A combination of intracavitary radiocobalt irradiation and external x-ray therapy to the paravesical tissues, in a manner similar to that employed in the treatment of cancer of the uterine cervix, is under consideration.

Eight figures; 2 tables.

RICHARD F. McCLURE, M.D.
Camp Pendleton, Calif.

The Value of the Measurements of Thyroid Uptake and Urinary Excretion of I^{131} in Assessing Thyroid Function of Normal and Congenitally Hypothyroid Children. William A. Reilly and Dina I. Bayer. *J. Pediat.* 40: 714-721, June 1952.

I^{131} in doses of 5 to 10 μ c was used to measure quantitatively both iodine uptake in the thyroid gland and urinary excretion in 25 euthyroid children and in 5 congenitally hypothyroid children (cretins). This dosage of radioiodine is smaller than that usually employed for such measurements, in order to avoid serious irradiation effects in the thyroid. The normal children were tested once each. The hypothyroid children were tested while taking 65 mg. of thyroid substance daily and again four to six weeks after discontinuance of this medication. This dosage of thyroid extract contained 130 μ g. of iodine. Excluding thyroid extract, the amounts of iodine received were below the usual daily requirement.

Over a ninety-six-hour period the thyroids of the normal children took up between 8.7 and 29.8 per cent of the I^{131} , the maximum uptake being reached between twenty-four and ninety-six hours after administration. The amount of I^{131} excreted in the urine during ninety-six hours ranged from 29.3 to 70.6 per cent, with the maximum excretion occurring between twenty-four and forty-eight hours.

Repeated tests showed the I^{131} uptake in thecretins

to be negligible (1 to 2 per cent); it was not appreciably influenced by thyroid therapy. When untreated, thecretins excreted 73.5 to 92.4 per cent of the I^{131} within ninety-six hours. While the samecretins were being treated, the excretion ranged between 35.8 and 84.5 per cent in the same length of time.

Four charts; 2 tables.

Recurrent Hyperthyroidism with Thyroid Crisis and Ventricular Tachycardia Successfully Treated with Radioactive Iodine (I^{131}): A Case Report. D. R. Bedford, F. E. Hoecker, and H. L. Hiebert. *J. Kansas M. Soc.* 53: 276-279, June 1952.

A 65-year-old woman was admitted to the hospital in severe thyroid crisis complicated by congestive failure with rapid irregular heart rate. She gave a history of thyroidectomies twenty-eight and twelve years previously. No thyroid tissue was palpable. A tracer study with radioactive iodine indicated marked hyperactivity of recurrent thyroid tissue in the pyramidal lobe and in the right lobe of the thyroid. A dose of 10 mc. of I^{131} was then administered and propylthiouracil therapy was instituted to help retain and thus enhance radioactivity, as well as for its own anti-thyroid effect in a very toxic patient. Two months later a repeat tracer study showed little remaining thyroid function. At the time of the report an excellent clinical result had been maintained for ten months.

Two drawings; 2 graphs; 5 electrocardiograms.

Direct Irradiation of Carcinoma of the Liver and Biliary Tract by the Use of Radioactive Iodine (I^{131}) in Tetraiodophenolphthalein: An Experimental and Clinical Study. Glover H. Copher, Vernon H. Wallingford, Wendell G. Scott, Garland G. Zedler, Boyd Hayward, and Sherwood Moore. *Am. J. Roentgenol.* 67: 964-973, June 1952.

The chemical procedures necessary for the production of radioiodine-labeled sodium tetraiodophenolphthalein are presented in detail. Experimental animal work, as expected, demonstrated concentration of the radioactive contrast medium within the gallbladder. The steps involved for radiation dosage determination are outlined for a dog weighing 18.6 kg. and receiving 21.1 mc. of radioactive tetraiodophenolphthalein intravenously. In this animal and others receiving similar amounts, the dose to the gallbladder wall appeared to be well below the cancerocidal level. Liver exposures, calculated in 3 animals, were considered to be within cancerocidal ranges according to the volume-dose concept of Mayneord and Clarkson.

Patients with inoperable carcinoma of the liver proved by exploratory laparotomy were then studied. These received varying amounts of radioactive tetraiodophenolphthalein (from a 34 mc. single dose to 338 mc. in divided doses over a seven-month period). In these patients fairly adequate liver values were attained, but the gallbladder did not concentrate well.

It is concluded that radioactive tetraiodophenolphthalein probably does not produce radiations in sufficient quantity (maximum of the order of several hundred rep in one week) to be therapeutically effective in cancer of the gallbladder, but that it may possibly be effective in the liver. It is suggested further that it should be possible to treat selectively with radiation by combining radioactive isotopes with elements or compounds that have special affinities for certain organs or

body systems. This technic, in effect similar to a "guided missile," holds promise for the future.

Three illustrations; 7 tables.

ZYGMUNT S. GIERLACH, M.D.
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Obliterating Tracheitis, a Complication Following Administration of Radioactive Iodine. Ruth Silberberg, Martin Silberberg, and Frank J. Dixon. *J. Lab. & Clin. Med.* 39: 256-259, February 1952.

During the course of studies on the skeletal effects of hypothyroidism and athyroidism employing radioactive iodine, I^{131} , a number of mice died from what proved to be a radiation tracheitis and peritracheitis. The radioiodine was given subcutaneously in a dose of 35 μ c. per gram of body weight. This relatively large dose was intended to destroy completely all thyroid tissue and to prevent subsequent regeneration of thyroid remnants or accessory thyroid glands. Destruction of thyroid tissue, however, was not complete under the conditions of the experiment, foci of distorted acini being occasionally present after four months. The tracheal lesions were observed within two to three months after the beginning of the treatment. Microscopic findings were typical of radiation reaction.

Internal Treatment of Mycosis Fungoides with P^{32} . Lars-Gunnar Larsson. *Acta radiol.* 37: 577-582, June 1952.

By reason of the fact that the lesions of mycosis fungoides show a relatively high uptake of phosphorus and are usually very radiosensitive, it seemed possible to the author that internal treatment with P^{32} might be

of value in this disease. In two advanced cases, reported here, remissions occurred and one of the patients obtained considerable benefit from the treatment. It should be pointed out, however, that the amounts of the isotope administered in both cases were unusually large, probably near the absolute tolerance level. Such large amounts are probably necessary if a pronounced effect on the lesions is desired. By serial measurements and by measuring the radioactivity in biopsy specimens, Marinelli and Goldschmidt (*Radiology* 39: 454, 1942) estimated the irradiation dose in the lesions in two cases to be about 1.3 to 1.5 rep when one microcurie per kilogram of body weight was administered. The authors state that, assuming uptake in their cases to be roughly of the same magnitude, the radiation dose in the lesions of their patients would be about 500 rep, delivered over several weeks. This dose is rather low and it seems improbable that significantly smaller amounts would cause adequate regression of lesions.

[The author believes that treatment with P^{32} is justified, particularly in patients with slowly progressive, very widespread infiltrations, mainly of the premycotic type, more especially as no other effective treatment exists for such a condition. This latter statement the abstracter takes exception to, inasmuch as he has had good palliative effects with roentgen irradiation over virtually the entire body, the treatments being carried out over a period of several weeks. However, the use of P^{32} may still be of value in the treatment of this disease.—R.A.E.]

Four photographs; 2 graphs.

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RADIATION EFFECTS

Emergency Measures and Precautions in Radium Accidents. Eugene L. Saenger, Robert G. Gallagher, David S. Anthony, and Peter J. Valaer. *J.A.M.A.* 149: 813-815, June 28, 1952.

Spilling of radium is a very serious accident which has cost institutions as much as \$100,000. To minimize the medical and financial risk of such an accident the authors give an excellent account, based on their experience in an industrial plant in Cincinnati, of just what to do if radium escapes from a sealed container. The article should be read and kept available in the original by everyone who uses radium, since few of us would immediately think of all the points the author mentions. For instance, one would think of radium immediately spreading through the air and would probably open windows, turn on fans, etc., but this merely disseminates the contamination and makes decontamination that much harder and more costly.

The first thing to do is to close off the area of the spill, making air-tight as small an area as possible. Every person possibly exposed should remove his clothing and scrub under a shower with a brush and soap or a detergent. Clothing should be examined with a monitoring instrument or put aside until one is available. Exposed persons should have complete blood counts, urinalyses, and radium assays of the urine collected for the next seventy-two hours. Feces should also be collected.

Anyone who probably or definitely did inhale or ingest radioactive material should have a gastric lavage with a 10 per cent solution of magnesium sulfate as soon as

possible and daily use of magnesium sulfate as a cathartic. If cuts and skin lesions cannot be decontaminated, surgical excision of the area should be considered.

Under no circumstances should any untrained person attempt to inspect or clean up any spilled radium salt.

If, as in the Cincinnati accident, the radium is in the form of the sulfate coprecipitated with barium sulfate, the radon produced is trapped almost quantitatively. Therefore, radon breath determinations are of uncertain value in measuring exposure to the sulfate. The insolubility of radium sulfate tends to permit less absorption in the body. Greater absorption of radium chloride and radium bromide can be expected after ingestion or inhalation.

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Do Roentgen-Ray Treatments as Given by Skin Specialists Produce Cancers or Other Sequelae? Follow-Up Study of Dermatologic Patients Treated with Low-Voltage Roentgen Rays. Marion B. Sulzberger, Rudolf L. Baer, and Alexander Borota. *Arch. Dermat. & Syph.* 65: 639-649, June 1952.

The investigations here reported were undertaken in the hope of supplying statistical information on the safety or risks of properly administered dermatologic roentgen therapy through a careful re-examination of the skins of a large group of patients who during the past five to twenty-three years had received superficial roentgen-ray treatments according to accepted derma-

tologic dosage schedules. In particular, the authors attempted to find the answers to the following questions:

1. When properly administered, do superficial roentgen-ray treatments for benign dermatoses, in the doses and qualities commonly employed by skin specialists in the United States, produce roentgen sequelae?

2. If roentgen sequelae do occur, under what conditions, dosages, etc., are they produced, and what is their incidence and their severity?

3. Do superficial roentgen-ray treatments, as generally given by skin specialists in the United States, predispose to the formation of skin cancers or other malignant changes of the skin?

Letters were sent to 18,050 patients treated at the Skin and Cancer Unit of New York University Hospital and of the New York University Post-Graduate Medical School. Up to the time of writing, 2,060 responses had been received. The present report is limited to 2,000 of the re-examined and evaluated group, namely, 1,000 irradiated patients and 1,000 non-irradiated "control" patients. The 1,000 irradiated patients had received superficial roentgen therapy for the following dermatoses: acne, 197; "eczema," 139; psoriasis, 36; skin cancer, 101; "neurodermatitis," 80; miscellaneous dermatoses, 447.

The doses of irradiation which had been given at the individual sittings varied from 37.5 r in benign dermatoses to 1,800 r in skin cancers. The number of treatments administered per site varied from 1 to 20. The number of sites irradiated in the individual patient ranged from 1 to 25, with an average of 2.1 sites per patient. There were 763 patients in whom no individual dose exceeded 85 r, and there were 237 to whom some individual doses of more than 85 r had been administered. Seven hundred twenty-four patients received a total of between 150 and 1,000 r; 201, a total of between 1,000 and 2,000 r, and 75, a total of over 2,000 r. Four hundred fifty-eight patients had received their treatments 5 to 7 years previously; 296 patients, 8 to 11 years previously; 220 patients, 12 to 15 years previously; 21 patients, 16 to 19 years previously; and 5 patients more than 20 years previously.

Roentgen sequelae were found in 28 patients. In 10 of these roentgen irradiation only had been employed; in the remaining 18 other methods of physical and surgical treatment had also been used. Twenty-six had received individual doses of more than 85 r.

Twenty-five of the patients with roentgen sequelae had been treated for skin cancers, in which, in order to achieve a cure, one may deliberately administer doses that are expected to produce some degree of roentgen injury. Another patient had been given 4,543 r for a keloid, and roentgen sequelae were expected when the treatment was given; from the cosmetic and functional point of view, the result was more acceptable than the keloid for which the irradiation was given. In all of these 26 patients the changes were, without exception, relatively mild and of purely cosmetic significance; there was no instance of ulceration or cancer formation.

Two patients with benign dermatoses who had received small fractional doses, *i.e.*, individual doses of 85 r or less, showed some evidence of roentgen sequelae.

All patients in the series were carefully examined for the presence of skin cancers both in previously irradiated and in non-irradiated skin areas. In the irradiated group, one epithelioma was found in each of 6 patients.

Five of these epitheliomas were located in skin areas which had never been irradiated. In the non-irradiated group, examination revealed one epithelioma in each of 9 patients.

The authors' conclusions are as follows:

"Superficial roentgen-ray treatments as given by dermatologists in the United States, in the doses necessary for the cure of cancers and other malignant growths of the skin, produce mild roentgen sequelae in about 25 per cent of cases.

"There is no evidence that any sequelae are produced by totals of 1,000 r or less of superficial roentgen-ray treatments in the fractional doses and in the qualities generally employed by dermatologists in the United States for the treatment of benign dermatoses (such as acne vulgaris, "eczema," "neurodermatitis," and psoriasis). When total doses of more than 1,000 r (in our series the range was between 1,000 and 2,630 r) are given, it may be expected that about 1.5 per cent of patients will exhibit roentgen sequelae which are relatively mild and of only cosmetic importance.

"There is no evidence that cancers, roentgen ulcers, or any other dangerous sequelae are produced, even with the very largest doses which most dermatologists today consider permissible for benign dermatoses (total, 1,400 r)."

An Inquiry into the Effects of X-Radiation upon the Heart from Multiple Thoracic Beams. E. M. Crawford, A. D. French, and R. O. Kornelsen. *J. Canad. A. Radiologists* 3: 36-37, June 1952.

There is no uniformity of opinion among radiotherapists on the possible deleterious effects of x-rays upon the heart. The authors believe that the biological effect of irradiation on the heart is greater than realized and suggest that all cases being treated for intrathoracic malignant tumors through multiple fields be studied in an effort to establish criteria which will permit some assessment of the functioning of the patient's heart before, during and after irradiation. They present an illustrative case. The heart rate, blood pressure, auscultatory character of the heart, heart size, and signs of cardiac failure were observed in a patient being treated through eight 4×15 cm. fields directed to the lower third of the esophagus. Electrocardiograms were also taken. At the time when the heart had received between 600 and 800 r, the pulse rate had increased to 100 beats per minute. Treatment was discontinued. During the succeeding seven weeks the heart rate gradually decreased to 69. The final electrocardiogram showed a change in the voltage of the T-wave indicative of improvement in the heart muscle.

RICHARD F. MCCLURE, M.D.
Camp Pendleton, Calif.

The Role of Ionizing Radiations in the Causation of Ovarian Tumors. Harold Speert. *Cancer* 5: 478-484, May 1952.

Ionizing radiations are suspected as a factor in the causation of certain ovarian tumors. The purpose of the present paper is to examine the evidence for such a relation. After a thorough review of previously published experimental observations and clinical records and the addition of new case material, the author concludes that therapeutic radiation has no etiological significance for human ovarian neoplasms.

Analysis of nine reports in which it was possible to gain an indication of the numerical frequency of the association indicates that the incidence of ovarian neoplasm in patients following a radiotherapeutic menopause is too low to be significant (0.16 to 1.0 per cent).

In the Tumor Clinic of Presbyterian Hospital, New York, 958 patients were followed for an average of 6.7 years after a radiotherapeutic menopause. Most of the patients received intra-uterine radium, the usual dose being 1,200 to 1,800 mg. hr. A smaller number of patients were treated by external roentgen rays. During the period of observation only four ovarian tumors became clinically apparent; two of these were malignant and two were benign.

At the same hospital a review of the past history of 500 women with ovarian neoplasms (343 cancers, 247 cystadenomas) disclosed that only 17 had a record of previous pelvic irradiation for benign conditions, 10 with radium and 7 with roentgen rays. In these 17 cases the spread of histologic types seems to indicate that a common etiologic factor was not operative.

There is direct evidence that ionizing radiations may be tumorigenic for the ovary in rodents (especially granulosa-cell carcinoma). This is attributed to complete or virtually complete suppression of estrogenic activity. In the human hormonal disruption may not be as complete because estrogens are found in significant amounts in the urine of women after the induction of a radium menopause.

The treatment of functional uterine bleeding is discussed briefly.

Three photomicrographs.

PRESCOTT B. HOLT, M.D.
Rochester, Minn.

Effect of Irradiation upon the Uptake of Labeled Phosphorus in Human Carcinoma of the Cervix. M. L. Taymor, N. Gold, S. H. Sturgis, J. V. Meigs, and J. MacMillan. *Cancer* 5: 469-477, May 1952.

On the basis of their own work and that of others relative to the increased desoxyribosenucleic acid (DNA) content of tumor tissue, the greater relative uptake of radioactive phosphorus in this DNA fraction, the more rapid turnover of this DNA fraction in tumor tissue, and a decrease in the nucleic acid content of tumors following irradiation, the authors have investigated the effects of irradiation upon the uptake of P^{32} in carcinoma of the cervix. In addition to the desoxyribosenucleic acid fraction, the authors have also studied, for the sake of completeness, the other phosphorus-containing fractions of the tumor tissue such as the acid soluble, phospholipid, and the ribosenucleic acid fractions.

Fourteen patients with cervical carcinoma and 5 with normal cervixes were studied. The procedure was to give each patient an intravenous dose of P^{32} amounting to 10 microcuries per kilogram of body weight. Forty-eight hours later a cervical biopsy was taken, and studies were made of the phosphorus fractions mentioned. The specific activity of each fraction isolated from the carcinomatous tissue was measured. The patient was then given roentgen therapy, a 2,000 r tumor dose, over the course of the next ten days. When this treatment had been completed, a second, similar dose of P^{32} was administered, and forty-eight hours later another cervical biopsy was performed, and the tissue fractionated as before.

These studies confirmed the results of earlier investigators in that the authors found roughly twice the uptake of P^{32} in the tumor cases as compared to the normals. There was no average fall in the total phosphorus and the phospholipid fractions, and only a minor reduction in the acid-soluble phosphorus fraction. A more marked average reduction occurred in both the nucleic acid fractions.

Correlation between a rise or fall in the specific activity levels and the histological radiation reaction in the individual cases was most marked in the desoxyribosenucleic acid fraction. This is further evidence that the desoxyribosenucleic acid is intimately connected with mitotic activity. Correlation in this fraction was present in 9 out of 11 cases.

Whether or not the increased uptake of radioactive phosphorus in the desoxyribosenucleic acid fraction of carcinomatous tissue and the reduction of this fraction following irradiation will prove to be an effective indication of radiosensitivity or radioresistance, the authors would not hazard a guess. Such studies are now in progress.

Six photomicrographs; 1 graph; 4 tables.

PAUL W. SCANLON, M.D.
Rochester, Minn.

Radiation Leukopenia and Cortisone. Chas. C. Burkell. *J. Canad. A. Radiologists* 3: 30-35, June 1952.

Whenever large fields are used in the x-ray treatment of malignant tumors, the depression of the hemopoietic system often prevents the administration of an adequate tumor dose. A rise in the leukocyte count following the use of Cortisone has been observed by various investigators, and the author therefore gave the hormone to 6 patients undergoing abdominal x-ray therapy. Two additional patients were given Cortisone after their leukocyte count had fallen to a dangerously low level. Four patients, who received similar x-ray therapy, without Cortisone, served as controls.

Large fields, employing the trunk-bridge technic as developed at Manchester, were used in all cases. A tumor dose of 2,500 r was the aim in all cases, but the integral dose, upon which the depression of the hemopoietic system is largely dependent, varied greatly from one patient to another.

The 4 patients in the control group showed a steady decline of leukocytes to approximately 2,000 white cells per cubic millimeter, occurring usually between the tenth and fifteenth day of treatment. The total number of leukocytes then leveled off between 2,000 and 3,000 white blood cells per cubic millimeter until the completion of treatment.

Six patients were given Cortisone in a single daily dose of 100 mg., intramuscularly, on each treatment day. In the 2 patients in which leukopenia had developed, the Cortisone was administered to determine its ability to overcome an already existent irradiation leukopenia. Daily records were kept of weight, blood pressure, white blood cell count, and emotional status. The usual blood chemistries and urine studies were made weekly. No patient showed evidence of Cortisone toxicity.

In 5 of the 6 cases receiving Cortisone, no serious depression of the leukocyte count developed. The depression which did occur became manifest more slowly than in the control series. The 2 patients who were

given Cortisone for an already existing leukopenia showed a prompt recovery of their white blood cell counts even though irradiation was continued.

The administration of Cortisone seemed to have little or no effect on nausea and vomiting, which was experienced by nearly all the patients.

Eight graphs.

RICHARD F. McCLURE, M.D.
Camp Pendleton, Calif.

Release of Heparin in Anaphylactic Shock in Irradiated and Non-Irradiated Animals. Frank C. Monkhouse, Edward Fidler, and John C. D. Barlow. *Am. J. Physiol.* 169: 712-720, June 1, 1952.

A study was made of the release of heparin in anaphylactic shock in irradiated and non-irradiated animals. The heparin was obtained from the blood by a direct chemical method and could be detected in amounts greater than 0.01 mg. per cent.

Rabbits, guinea-pigs and rats were subjected to single large doses of total-body irradiation. The radiation factors were: 200 kv.; 20 ma.; inherent filtration 1.0 cm. Al and 0.25 cm. Cu, added filtration 0.25 cm. Cu; 100 r in 2.9 minutes; distance 50 cm. Several dogs were given slow continuous gamma irradiation in lethal amounts from a Co⁶⁰ source.

No heparin could be found in the blood of the irradiated rats, and anaphylaxis could not be produced in this species for further testing.

In the irradiated guinea-pigs, no heparin was found in the blood before shock. After shock, heparin appeared in the blood, although there was no significant change in clotting time. The irradiation did not appear to influence the amount of heparin released in comparison with non-irradiated animals.

No heparin was found in the blood of irradiated rabbits before shock. After shock, heparin appeared in the blood, but there was only slight effect on clotting time. Irradiation tended to increase the heparin output in response to a given amount of antigen, provided this amount caused a submaximal response in the non-irradiated animal.

In dogs given slow but fatal irradiation, no heparin was found in the blood before shock. Heparin was released readily during shock and had a pronounced effect on clotting time. Irradiation tended to increase the heparin produced by a given dose of antigen, provided this dose caused a submaximal response in sensitized non-irradiated dogs.

Three figures; 3 tables.

Factors Effecting X-Ray Inhibition of Antibody Formation. L. O. Jacobson and M. J. Robson. *J. Lab. & Clin. Med.* 39: 169-175, February 1952.

Young adult rabbits were exposed to dosages of 800 r or 500 r total-body x-irradiation with spleen shielding. Physical factors were as follows: 250 kv., 15 ma., 1.0 mm. Cu and 3.0 mm. Bakelite filtration. The half-value layer in copper of the filtered beam was 2.0 mm. The dose rate averaged 15.5 r per minute at 33 inches. Twenty-four hours post-irradiation the spleen was removed surgically. After another twenty-four-hour period (forty-eight hours after irradiation), a particulate antigen (sheep red cells) was given intravenously. The capacity of the rabbits to form antibodies (anti-sheep cell hemolysin) was compared with various control groups given the same antigen at the same relative time as the group described above. Controls consisted of

(1) animals not irradiated but which had surgical exteriorization of the spleen only, (2) animals that were not irradiated but were subject to splenectomy, (3) animals that were irradiated without spleen shielding or other surgical manipulation, (4) animals exposed to radiation with spleen exteriorization, without shielding, but with subsequent splenectomy, (5) animals that were irradiated with spleen shielding but had no subsequent splenectomy.

The data presented show that the capacity to form antibodies to an injected antigen is retained in rabbits exposed to 800 r or 500 r total-body irradiation if the spleen is shielded during irradiation, left intact in the circulation twenty-four hours after irradiation, and then removed surgically even though the antigen is given twenty-four hours after splenectomy and forty-eight hours after irradiation. The fact that these rabbits retain the capacity to form antibodies even though hematopoietic tissue in the body is atrophic, while control rabbits exposed to 800 r or 500 r do not retain this capacity, is considered to be a result of the functional restoration of cells in the body (such as free and fixed macrophages and reticular cells) by a humoral (non-cellular) substance entering the general circulation from the originally shielded spleen during the twenty-four hours prior to splenectomy.

Genetic Modification of Response to Spleen Shielding in Irradiated Mice. Henry S. Kaplan and Janice Paull. *Proc. Soc. Exper. Biol. & Med.* 79: 670-672, April 1952.

Jacobson and his co-workers have demonstrated that shielding of the exteriorized spleen will protect CF-1 mice against lethal doses of whole-body x-irradiation (*J. Lab. & Clin. Med.* 34: 1538, 1949, and 35: 746, 1950. *Abst. in Radiology* 55: 639, 1950, and 56: 635, 1951). Hematopoietic activity in the shielded spleen is greatly stimulated within the first twenty-four hours after irradiation and recovery of hematopoietic elements in the bone marrow occurs sooner than in sham-shielded irradiated controls. In other species, however, spleen shielding has reportedly been only partially protective. The present authors investigated the response in two different inbred strains of mice.

Mice of strains A (Strong) and C57 black, of both sexes, were divided equally with respect to age (range 32-60 days) into three groups. One group was kept intact and received a single whole-body dose of 550 r. Physical factors were 120 kv.p., 9 ma., 0.25 mm. Cu plus 1.0 mm. Al added filter, 30 cm. mouse-target distance, 32 r per minute. The spleens of the other two groups were exteriorized and placed, respectively, in lead or paraffin shields during irradiation.

A significant difference in response between the two strains of mice was observed, associated with apparent differences in histologic appearance of the shielded spleens after irradiation.

It appears from this study that the protective effect of spleen-shielding in irradiated mice may be genetically conditioned, and related to the importance of the spleen in the hematopoietic system of each strain.

Whole Body X-Irradiation of Obese Mice. Willie W. Smith, W. H. Chapman, and I. M. Alderman. *Am. J. Physiol.* 169: 511-514, June 1, 1952.

Mice made fat by gold thioglucose injection and mice with hereditary adiposity had the same incidence of death following whole-body irradiation as litter-mate

controls of normal size. Radiation factors were 200 kv., 20 ma., 0.25 mm. Cu and 0.51 mm. Al added filtration, 50 cm. target distance. Survival time and weight loss after irradiation were essentially the same in fat as in control mice, while in non-irradiated starved mice survival time and total weight loss were about three times as great in the obese mice as in their controls. These results strongly suggest that starvation is not responsible for death in mice following radiation either in the range where survival time is nine to fourteen days (500 r) or three and a half to four days (2,000 r).

One chart; 1 table.

Origin and Behavior of Two Transplantable Lymphomas Induced by X-Radiation. Emma Shelton. *J. Nat. Cancer Inst.* 12: 1203-1223, June 1952.

Two tumors designated Lymphoma #1 (L #1) and Lymphoma #2 (L #2) were found, in July 1946, in six-month-old Strain A female mice that had been exposed to 400 r x-irradiation (total-body) at birth. Both tumors have been transplanted and carried in this strain for over one hundred generations with 100 per cent takes and no spontaneous regressions. Lymphoma #1 grows as a localized lymphosarcoma, whereas Lymphoma #2 is a highly invasive, acute lymphocytic leukemia. When L #1 is transplanted, the tumor grows as a local mass at the injection site and kills the host after thirty to forty days. Although the tumor is not encapsulated and in the process of growth invariably invades the muscles of the abdominal wall, it does not show distant metastases. Between seven and ten days after injection of L #2, leukemic cells enter the blood stream and progressively invade the spleen, lymph nodes, bone marrow, liver, lungs, adrenal glands, and kidneys. Animals begin to die after nine days.

Although L #1 does not metastasize widely, its growth in the host stimulates mitotic activity in the cells of the liver parenchyma and causes an enlargement of the centers of the lymphatic nodules of the spleen and lymph nodes of the host. This physiological influence on the liver supports the hypothesis of Bucher *et al.* (*Cancer Research* 11: 457, 1951) that a blood-borne factor is concerned in the stimulation of mitotic activity in the liver. The evidence suggests that when an actively dividing tissue shares a common blood supply with the liver, the liver cells are stimulated to divide.

Chemical determinations showed that L #1 contained no detectable alkaline phosphatase activity but relatively high acid phosphatase activity. L #2 had high alkaline phosphatase activity but lower acid phosphatase activity than L #1.

Twelve photomicrographs; 2 graphs; 2 tables.

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Failure of Rutin and Related Flavonoids to Influence Mortality Following Acute Whole Body X-Irradiation. Maxwell Dauer and J. M. Coon. *Proc. Soc. Exper. Biol. & Med.* 79: 702-707, April 1952.

In view of the conflicting reports concerning the value of the flavonoids in reducing the mortality of animals exposed to acute whole-body x-irradiation, the authors have carried out further studies on the possible usefulness of these compounds. A total of 1,132 CF₁ female mice, 232 female Sprague-Dawley rats, and 70 female guinea-pigs were used in the investigation. Physical factors for irradiation were: 250 kv p., 15 ma., inherent filtration 0.25 mm. Cu, with an added filter of 0.25 mm. Cu plus 1.0 mm. Al. For the mice, the target distance was 60 cm. and the dose rate 48 to 50 r per minute; for the rats and guinea-pigs the distance was 75 cm. and the dose rate 31 to 36 r per minute.

Rutin, rutin complexes with piperazine hexahydrate, and de-ionized rutin administered to mice by different routes had no protective action against the lethal effects of whole-body x-irradiation in doses of 500, 600, 700 or 800 r.

Quercitrin, quercetin, hesperidin, hesperidin methyl chalcone, dihydroquercetin, naringen, calcium flavonate, xanthorhamnin, morin (di-ionized), citrus vitamin P (CVP), and lemon juice infusion (LPI), administered in the diet, had no protective action on mice exposed to acute whole-body irradiation.

Rutin complex, hesperidin methyl chalcone, and citrus vitamin P had no protective effect on rats and guinea-pigs exposed to acute whole-body irradiation. Supplemental vitamin C did not enhance the action of the flavonoids or decrease mortality.

The LD 50 of 250-kv.p. x-rays, based on the thirty-day mortality for the CF₁ mice used in this experiment, was approximately 550 r.

One table.



April 1953

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